DETERMINANTS OF COMMERCIAL BANK LIQUIDITY IN SOUTH AFRICA

by

THEMBA INNOCENT LUVUNO

submitted in accordance with the requirements for
the degree of

MASTER OF COMMERCE

in the subject Business Management

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: DR GODFREY MAROZVA

(28 June 2018 submitted)

ABSTRACT

This study examined the determinants of commercial bank liquidity in South Africa. The panel regression approach was used, applying panel data from twelve commercial banks over the period 2006 to 2016. A quantitative research method was used to investigate the relationship between bank liquidity and some microeconomic and bank-specific factors and between bank liquidity and selected macro-economic factors. The regression analysis for four liquidity ratios was conducted using the pooled ordinary least squares regression, fixed effects, random effects and the generalised methods of moments. However, the system generalised methods of moments approach was preferred over the other methods because it eliminated the problem of endogeneity. Results show that capital adequacy, size and gross domestic product have a positive and significant effect on liquidity. Loan growth and non-performing loans had a negative and significant effect on liquidity. Inflation had both a positive and a negative but an insignificant effect on liquidity.

The study concluded that South African banks could enhance their liquidity positions by tightening their loan-underwriting criteria and credit policies. Banks should improve their credit risk management frameworks to be more prudent in their lending practices to improve the quality of the loan book to enhance liquidity. They also need to grow their capital levels by embarking on efficient revenue enhancements activities. Banks may also to look at their clients on an overall basis and not on transaction bases, and they need to improve non-interest revenue by introducing innovated products. The South African Reserve Bank could push for policies that might enhance capitalisation by ensuring that the sector is consolidated and thus merging smaller banks to create banks with stronger balance sheets and stronger capital base.

This study contributes to the empirical research repository on the determinants of liquidity and more specifically, it identified the significant factors that affect South African commercial bank liquidity. Identifying the determinants of South African commercial bank liquidity will provide the South African Reserve Bank with insight into ways of enhancing liquidity management reforms, to improve the sector's liquidity management practices and help to maintain a sound and liquid banking sector.

Key words: *bank liquidity, liquidity risk, determinants of liquidity, global credit crisis, market liquidity, funding liquidity.*

ACKNOWLEDGEMENTS

Firstly, I would like to thank the Almighty God for making this possible. Without Him, I would not have made it.

I would also like to especially thank my wife, Cleodine Meshell Luvuno, for her unwavering support throughout this journey and during the times when I had to work tirelessly at night to ensure that I completed this thesis. I dedicate this study to my beautiful daughter, Zia Teshell Ntombikayise Luvuno, who was born during the time when I was diligently working to complete the thesis. A big thank you to my grandmother Esther Nomgojo for her diligent support and for always believing in me. I would like to thank my family and friends who were with me during this journey.

To Dr Godfrey Marozva, thank you for your support even when I wanted to give up. You encouraged me and assisted me in every way you could. I thank God for a supervisor like you, who is God-fearing and who always saw the best in me when I did not. You were always available to assist me, even when I did not adhere to our agreed timelines.

Finally, a big thank you to Jackie Viljoen, for providing editorial assistance. I am responsible for any other errors.

DECLARATION

Name: Themba Innocent Luvuno

Student number: 3205-766-0

Degree: MCom – Financial Management

Exact wording of the title of the dissertation as appearing on the copies submitted for examination:

DETERMINANTS OF COMMERCIAL BANK LIQUIDITY IN SOUTH AFRICA

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE DATE

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LIST OF ABBREVIATIONS AND ACRONYMS

ARDL	autoregressive distributive lag
ASI	all share index
BA	bankers acceptances
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlements
CAP	capital adequacy ratio
CAPDR	Central America, Panama and the Dominican Republic
CD	certificate of deposit
CP	commercial paper
CPI	consumer price index
EDS	eligible development stocks
FDI	foreign direct investment
FE	fixed effects
FEM	fixed effects model
FSB	Financial Services Board
GDP	gross domestic product
GMM	general methods of moments
GMS	growth of money supply
HQLA	high-quality liquid assets
LCR	liquidity coverage ratio
LG	loan growth
MR	monetary rate
NPL	non-performing loan
NPO	non profit organisation
NSFR	net stable funding ratio

OECD	Organisation for Economic Co-Operation and Development
OLS	ordinary least squares
RE	random effects
REM	random effects model
ROA	Return on assets
SARB	South African Reserve Bank
SD	standard deviation
TB	Treasury bill
TC	Treasury certificate
TOL	Tolerance
VIF	Variance inflating factors
WGL	Working Group on Liquidity

CHAPTER 1: OVERVIEW

1.1 INTRODUCTION AND BACKGROUND

According to Sambaza (2016), banks are critical to the economy as they link borrowers and lenders, by ensuring that there is sufficient supply of liquidity to borrowers, while banks attract deposits from depositors and pay these depositors a reasonable return for the deposits. In order to execute this function, banks have to adhere to robust liquidity management practices and maintain sound governance processes. It is within this context, that this study aimed to investigate the determinants of bank liquidity in South Africa.

If banks maintain sufficient liquidity, it brings about stability to the financial sector and provides the public with confidence in them. Therefore, in order for economic development to take place, the banking sector must be sound and have sufficient liquidity buffers to be the catalyst to economic activity (Sambaza, 2016). According to Bunda and Desquilbet (2008), large banks normally face financial distress, which is caused by common factors, such as credit margins and asset market liquidity. It is for this reason that commercial banks are encouraged to hold liquidity buffers of liquid assets in order to be able to have prudent liquidity management processes (Mugenyah, 2015). Therefore, and understanding of what drives liquidity, persuaded the carrying out of this research.

According to Sheefeni and Nyambe (2016), as opposed to other risks, liquidity risk and its management have not received the attention that they deserve. However, the 2007 to 2009 global credit crisis brought about new changes and alerted a shift to focus on the importance of prudent liquidity risk measurement and management. These actions are in line with the view that there are benefits to holding more liquid assets when economic conditions deteriorate (Mugenyah, 2015). Therefore, even though the ultimate objective of commercial banks is to maximise their profits, preserving liquidity is just as important.

Various authors, such as Vodova (2013) and Trenca, Petria and Corovei (2015), have contributed to the literature on liquidity risk management and the determinants of liquidity, and they applied different measures of liquidity risk in their research. Authors Vodova (2013) and Trenca et al. (2015) have conducted empirical studies on bank

specific determinants of liquidity. Studies conducted by Vodova (2013) identified factors such as inflation rate, monetary policy interest rate, lending rate and unemployment rate as determinants of liquidity. Trenca et al. (2015) identified macroeconomic factors, such as unemployment rate and gross domestic product (GDP) as determinants of bank liquidity.

Determinants of liquidity can be viewed in light of liquidity creation. Liquidity creation can be seen in two perspectives: firstly, there is the core function of banks, but banks can also be the major contributor of risk (Diamond & Dybvig, 1983). Tesfaye (2012) indicates that banks' equity in the form of retained earnings and capital has the potential of being negatively affected by liquidity risk, and it is thus imperative for banks to maintain sufficient liquidity buffers to ensure that they are able to meet the expected demands. Consequently, banks actually collect short-term deposits and issue long-term loans, which result in a mismatch between assets and liabilities, exposing them to liquidity runs or liquidity risk (Diamond & Dybvig, 1983). A 'liquidity run' refers to a bank being unable to meet its clients' demands, which has the potential to lead to a lack of confidence in the entire banking system (Tesfaye, 2012: 11). Diamond and Rajan (2001) also confirm that an unexpected high rate of deposit withdrawal results in a bank liquidity run. The inevitability of the existence of a bank run results in banks investing in activities that will yield a return. In order for this to be achieved, banks have to adopt prudent liquidity risk management practices to ensure effective management of assets and liability maturities. Bank liquidity runs are the result of poor liquidity management and has the ability to disrupt production because they force banks to call in loans early, forcing borrowers to disrupt their production (Diamond, 2007).

Since the 2007–2009 crisis, there have been collective as well as individual efforts internationally to establish or reform existing liquidity risk frameworks, most notably by the Basel Committee for Banking Supervision (BCBS). In 2008, the BCBS published its liquidity framework called "Principles for Sound Liquidity Risk Management and Supervision" (see Bank for International Settlements (BIS), 2008: 1), to provide guidance on the risk management and supervision of funding liquidity risk and help enhance risk management, especially in the area of liquidity. In 2010, the BCBS released a publication, "Basel III: International framework for liquidity risk

measurement, standards and monitoring" (see BIS, 2010: 1A), which contains among other things, enhanced liquidity framework guidelines. These guidelines would have big impact on banks, because banks would be required to hold a level of capital and liquidity higher than in the past. This would inevitably also have an effect on the liquidity creation function performed by banks (Horvat, Seidler & Weill, 2012).

According to BIS (2010), the Basel III framework, which is part of the liquidity framework, highlights the importance of good liquidity risk management, which inter alia includes two minimum standards for funding liquidity risk. These standards have two separate but matching objectives. The first objective is to ensure that banks have a robust short-term liquidity risk profile by ensuring that they have sufficient high-quality liquid assets to survive a significant stress scenario lasting for one month by developing the liquidity coverage ratio (LCR) (BIS, 2010).

According to (BIS, 2015), the second objective is to ensure that banks have a resilient longer-term (longer than one year) structural liquidity profile by creating additional incentives for banks to fund their activities with more stable sources of funding on an ongoing basis, by developing the net stable funding ratio (NSFR) (BIS, 2015).

The new regulation, supervisory standards and requirements issued by the BCBS as well as by the Financial Stability Board (FSB) (see South African Reserve Bank (SARB), 2011) necessitated a continuous review and assessment of the SARB banking supervisory department's domestic regulatory and supervisory framework, to ensure that the SARB was associated with international standards (SARB, 2011). During 2011, the supervisory department incorporated the enhancement of the Basel II framework in the domestic regulatory and supervisory framework and the amended framework was effective January 2012 (SARB, 2011). The SARB noted that it would be implementing the LCR and NSFR (part of the Basel III framework) as proposed by the BCBS in a phased-in manner from January 2015 and January 2018, respectively (SARB, 2011: 1). According to (BIS, 2015), the SARB ensured that all South African banks and banking groups implemented the LCR framework through regulations that were issued in 2012 and were subsequently updated through Directives in 2013 and 2014.

According to the SARB (2016), South Africa is affected by global developments brought about by the turbulent financial markets and liquidity challenges experienced globally. This resulted in South Africa adopting the Basel Accord, given that it forms part of the global economy (see SARB, 2016). The SARB established a Working Group on Liquidity (WGL) in 2013 (see SARB, 2016) to focus primarily on policy development. The WGL also has the oversight function to deal with challenges relating to the successful development, implementation and maintenance of the liquidity framework that addresses the regulatory requirements and expectations of the BCBS relating to funding and liquidity (SARB, 2016). The WGL has developed appropriate standards for measuring and mitigating liquidity risks, with specific reference to the two main standards, namely the LCR and the NSFR (SARB, 2016). The WGL will also evaluate whether the elements of the principles of sound liquidity risk management, published by the BCBS in 2008 (see BIS, 2008)) should be regarded as best practice for liquidity management in South Africa (SARB, 2016). The introduction of new liquidity framework guidelines by BCBS and by the SARB will have an impact on South African banks, because they will now be required to hold a level of capital and liquidity higher than in the past. This will inevitably also have an effect on the liquidity creation function performed by banks (Horvat et al., 2012). Taking into account how imperative liquidity is in the banking sector, it was the aim of this study to contribute to this important subject through investigating the main determinants of bank liquidity.

1.2 PROBLEM STATEMENT

The 2007–2009 global credit crisis (see BIS, 2008) has triggered an improvement in liquidity risk management, which emanated from the Basel III framework, which was expected to bring about stability within banking sectors (BIS, 2010). Several researchers (e.g. Berger & Bouwman, 2009; Brunnermeier & Pedersen, 2008) have contributed literature, which confirms that liquidity was the catalyst behind the 2007–2009 global credit crisis.

The global credit crisis prompted several researchers globally to conduct studies regarding the determinants of bank liquidity. Results from a study conducted by Vodova (2011) on the determinants of commercial banks liquidity in Czech Republic, confirmed that inflation, the business cycle and the global credit crisis have a negative effect on liquidity. A Study by Vodova (2011) on the determinants of commercial banks

liquidity in Slovakia confirmed that bank liquidity decreases mainly due to the global credit crisis. Liquidity of banks increases with the growth in GDP and decreases with higher unemployment. However, interest rates and rate of inflation have no statistically significant effect on liquidity (Vodova 2011). Choon, Hooi, Murthi, Yi and Shven (2013) conducted a study on the determinants of bank liquidity in Malaysia. The study included macroeconomic factors, such as GDP, interbank rate and financial crisis. The results showed that all factors included were significant except interbank rate. Among these factors, GDP positively affects bank liquidity while financial crisis influences bank liquidity negatively (Choon et al., 2013). Vodova (2013) also conducted a study on the determinants of liquidity in Hungarian banks, which confirmed that bank liquidity is positively related to monetary policy interest rate, while the relationship between growth rate, real GDP and liquidity is ambiguous.

In Africa, Laurine (2013) conducted studies on the determinants of bank liquidity risk in Zimbabwe. The results confirmed that interest rate spreads have a positive influence on liquidity risk. Reserve requirement ratios and inflation were also significant in explaining liquidity risk during the study period. In Morocco, Ferrouhi and Lehadiri (2013) conducted a study which confirmed that liquidity is mainly determined by foreign direct investment (FDI), monetary aggregate M3 (see Ferrouhi and Lehadiri 2013), foreign assets, growth rate of GDP, public deficit, inflation ratio and the effects of the financial crisis. Liquidity is positively correlated with monetary aggregate M3, foreign assets and FDI, and negatively correlated with inflation rate, growth rate of GDP, public deficit and financial crisis. However, unemployment rate has no effect on the liquidity of a bank. Finally, Moussa (2015) conducted a study on the determinants of bank liquidity in Tunisia. The results confirmed that growth rate of GDP and inflation rate have a significant effect on bank liquidity.

Looking at the various studies conducted by several authors on the determinants of bank liquidity and the regulatory framework reforms by the BCBS, it is evident that liquidity and liquidity risk are topical issues. Therefore, this study aimed to identify the determinants of commercial bank liquidity in South Africa and built on studies conducted by other authors, such as Moussa (2015) and Tesfaye (2012). The present study was motivated by the fact that the recent crisis did not spare the South African economy, as the crisis induced the economic slowdown in 2009 (Baxter, 2009).

According to the author's knowledge, there are one or two studies (see Marozva, 2017), which indirectly examined the determinants of commercial bank liquidity in South Africa, and this study would add to the repository of these studies. Taking into account the fact that most of the studies on the determinants of liquidity were done before the 2007–2009 financial crisis, this study covered the period during and after the financial crisis. Moreover, the relationship between bank liquidity and macro- and micro-economic variables is not conclusively determined, as literature shows opposing views on the direction and significance of the variables under investigation. Therefore, the main aim of this study was to investigate the determinants of bank liquidity in South Africa further. South Africa is a new democracy and an emerging market, and this means it has unique characteristics, which differ from mature democracies and well-developed markets.

1.3 RESEARCH OBJECTIVES

This study had the following objectives:

1. to examine the relationship between capital adequacy and bank liquidity;
2. to determine the relationship between bank liquidity and bank size;
3. to determine the relationship between bank liquidity and loan growth;
4. to investigate the relationship between bank liquidity and non-performing loans; and
5. To examine the connection between macroeconomic factors and bank liquidity.

1.4 CONTRIBUTION OF THE STUDY

The present study aimed to add to the literature on determinants of commercial bank liquidity, and focused specifically on South African commercial banks. The findings of this study will add to the empirical research repository on this topic and will identify the significant factors that may affect South African commercial bank liquidity. This study also identified factors over which commercial banks have control and the way to manage those better, in order to ensure that liquidity risk is efficiently managed. Identifying the determinants of South African commercial bank liquidity will also give the SARB (the regulatory body) insight into ways of enhancing liquidity management

reforms, to place the sector's liquidity management practices better and to help maintain a sound and liquid banking sector. This study will also open doors for other researchers to perform further studies in this field.

1.5 OVERVIEW OF THE SOUTH AFRICAN BANKING SECTOR

1.5.1 Composition of the South African banking sector

According to SARB (2017), as at 31 December 2017, the sector had 34 banking institutions (excluding three mutual banks, but including one institution conducting banking business in terms of an exemption from the provisions of the Banks Act 94 of 1990 ('the Banks Act'), namely Ithala SOC Ltd (see SARB, 2016). The number of banks registered or licensed is reflected in Table 1.1 below:

Table 1.1 South African banking sector: Number of banks registered or licensed

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Banks*	19	19	18	17	17	17	17	17	17	17	19
Branches of international banks in South Africa	14	14	13	13	12	14	14	14	15	15	15
Total banks	**33**	**33**	**31**	**30**	**29**	**31**	**31**	**31**	**32**	**32**	**34**

**Includes active banks and banks exempted by the Registrar of Banks (with effect from 1 July 1996) in terms of the Supervision of Financial Institutions Rationalisation Act, 32 of 1996 and section 1(CC) of the Banks Act, 1990.*
Source: SARB (2017)

1.5.2 Position and performance of the South African banking sector

According to SARB (2017), as at 31 December 2017, the banking sector's total assets amounted to R5,16 billion and the sector's five largest banks by total assets continued to dominate the sector by holding more than 90,5% of the sector's total assets. The sector's total capital adequacy ratio remained well above the regulatory minimum of 10,0%. The average liquid assets held by banks remained well above the minimum requirement. Banking sector assets were mainly funded by deposits, current accounts and other creditors, which constituted 86,4% of banking-sector liabilities at the end of December 2017. Wholesale funding represented the largest part of funding and represented 41,1% of total funding as at the end of December 2017. Retail deposits represented 26,3% of funding as at December 2017 (SARB. 2017).

According to the SARB (2017), the LCR remained elevated above the minimum requirement of 80,0%, amounting to 119% as at December 2017, having increased as banks continued to accumulate stocks of high quality-liquid assets.

1.5.3 Explanation of liquidity within the South African banking sector

According to Marozva (2017), the South African banking sector has experienced a regulatory and technological development between 1994 and 2016. However, this development was coupled with increased costs, which were specific reference to regulatory, competition and technological costs, according to Kumbirai and Webb (2010). This development has resulted in an increase saturation of foreign banks, brought about by the country's attainment of democracy in 1994 (Kumbirai & Webb, 2010). Figure 1.1 shows how the aggregate assets and liabilities of South African banks grew over the years.

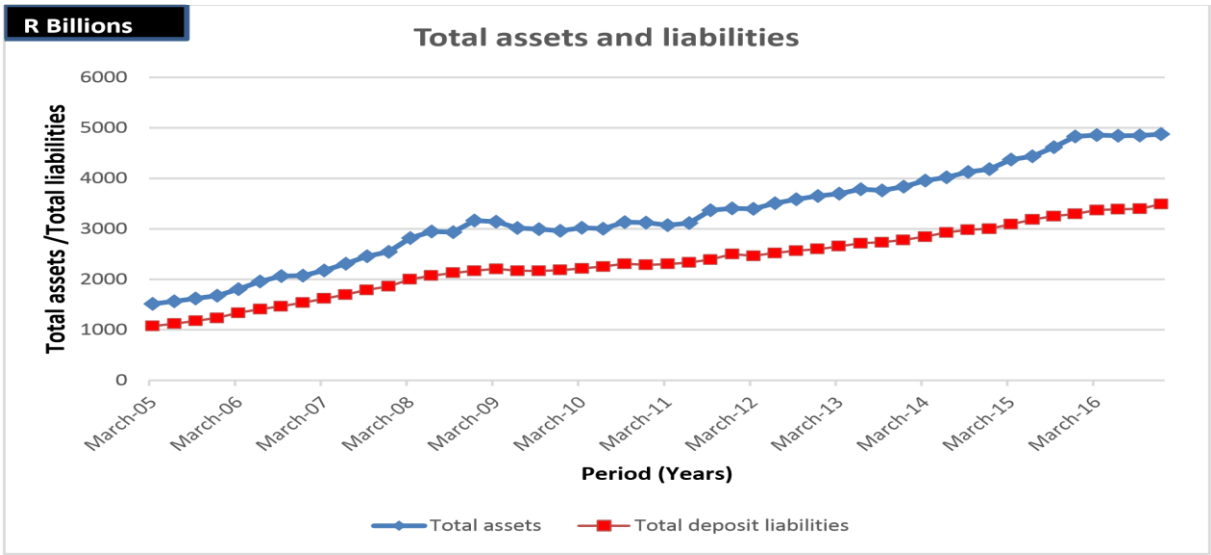

Figure 1.1 Total assets and liabilities

Source: Marozva (2017)

The soundness of the South African banking sector is highlighted by its performance during and after the 2007–2009 global crisis, and this has resulted in several studies being conducted on the South African banking sector performance and efficiency (Erasmus & Makina, 2014). A few studies were conducted by Visser (2013) and Van Vuuren and Visser (2014) on bank liquidity in South Africa. However, Van Vuuren & Visser (2014) built a liquidity stress testing model (see Van Vuuren & Visser, 2014:

702-704) but did not examine the main determinants of liquidity risk (see Van Vuuren & Visser, 2014). Moreover, the model by Van Vuuren and Visser (2014) was not tested within a context of other liquidity stress testing measures such as the NSFR and the LCR.

According to Marozva (2017), total assets increased by 333% from March 2005 to March 2016, which is on average 30,27% increase per annum. Total liabilities increased by 320% from March 2015 to March 2016, averaging to 29% increase per annum (Marozva, 2017). However, some developments during the 2007–2009 crisis resulted in a highly volatile asset base and a slight decrease of 3,23% in the value of assets and this decrease in the value of assets is explained by the liquidity spirals (Marozva, 2017). Brunnermeier and Oehmke (2012) argue that during crisis, first, there was a loss of spiral that was triggered by the decrease in asset prices, which led to forced selling resulting in the erosion of capital. The second liquidity spiral was the margin spiral, which mainly pertained to the liability side of the balance sheet (Brunnermeier & Oehmke, 2012). From Figure 1.1, it is clear that liabilities continued increasing in the midst of the economic recession, which was an indication that some of the banks could have failed to honour their obligations and rolled over their liabilities. Liquidity spirals could explain this as volatility increased, margins and haircuts increased, thereby increasing bank liabilities (Marozva, 2017).

The global financial crisis of 2007–2009 was synonymous with a liquidity crisis. Liquidity plays a central role in the operations of a financial institution and a shortage of liquidity leaves the general economy in mayhem (Marozva, 2017). López-Espinosa, Moreno, Rubia and Valderrama (2012) note that short-term funding (funding liquidity) is the most important determinant of the contribution of a bank to global systemic risk. Liquidity risk in South Africa deserves greater scrutiny. The present study was motivated by the fact that the recent crisis did not spare the South African economy, as the crisis induced the economic slowdown in 2009 (Baxter, 2009). The South African economy started slowing down in the fourth quarter of 2008 and officially entered into a recession in the first quarter of 2009 (Baxter, 2009).

Focusing on the period under investigation, Figure 1.2 below shows that South African banks on aggregate increased their liquid assets from 2005 until the end of 2008. In 2009, South Africa witnessed a decrease in liquid asset holdings by banks due to the

adverse effects of the global financial crisis. In response to the liquidity crisis, South African banks increased their liquid assets exhibited by an increase in liquid assets by the end of 2010 (see Marozva, 2017). Marozva (2015) indicates that, in periods of turmoil, the strength and resilience of the banking sector should be measured in terms of how liquid the bank is instead of its balance sheet or profitability.

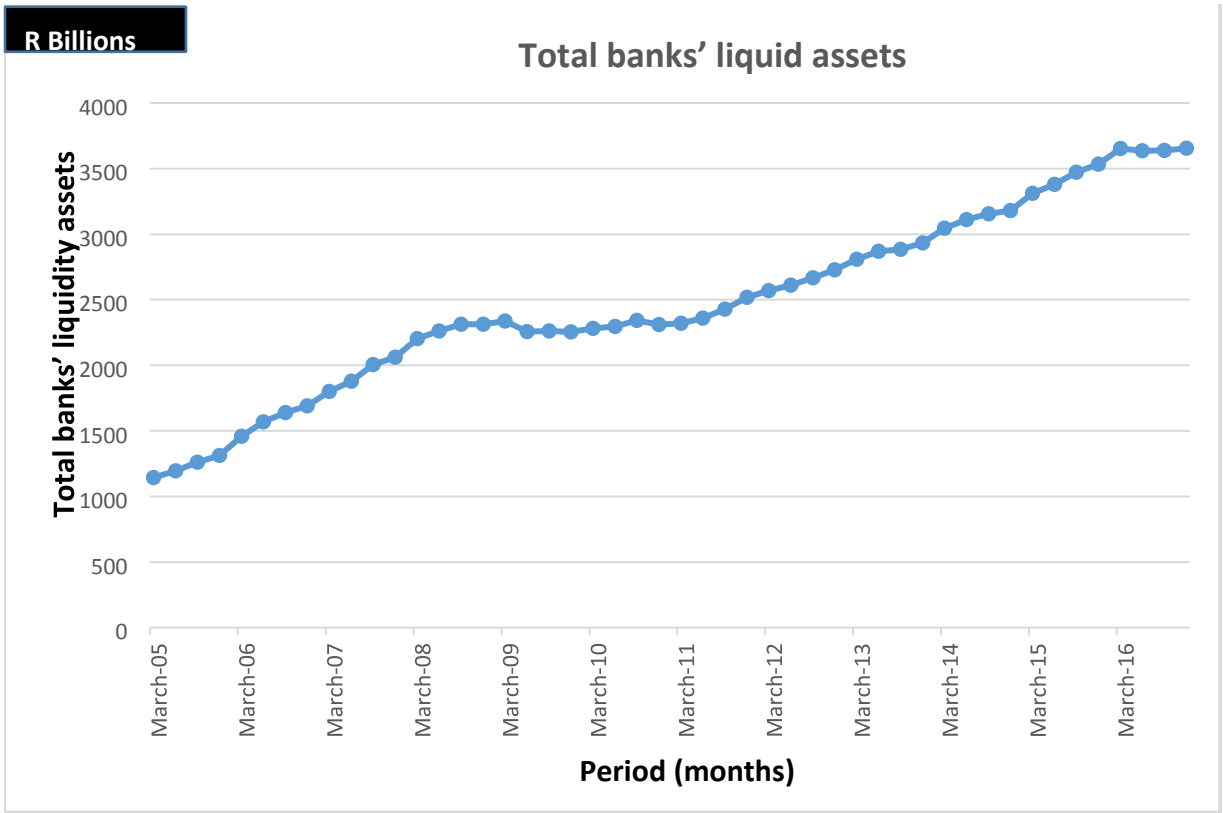

Figure 1.2 Liquid assets.

Source: Marozva (2017)

1.6 OVERVIEW OF CHAPTERS

This thesis will be organised into six chapters.

Chapter 1: Introduction and background

Chapter 1 provides an introductory background on the research study, as well as the objectives of the study and the structure of the thesis.

Chapter 2: Liquidity – theories and empirical studies

Chapter 2 will provide the definition of the main variables, provide a summary of the literature review and empirical evidence of bank liquidity in general.

Chapter 3: Empirical studies

Chapter 3 will focus on observations and findings from studies conducted by several authors on the topics relating to determinants of bank liquidity globally.

Chapter 4: Research questions, hypothesis development, research methodology, design and econometric methods

This section gives more detail of the main objectives of the study, the methodology that was applied in addressing the research objectives. The various research designs and econometric models were deliberated and the generalised methods of moments (GMM) model was selected to test the hypotheses.

Chapter 5: Data presentation, analysis and interpretation

Chapter 5 provides the analysis and interpretation of the econometric test results In this chapter, the research techniques discussed in Chapter 4 were employed to empirically test the liquidity measures against their determinants. The liquidity ratios were tested empirically by regressing them against the bank-specific factors as well as macro-economic factors

Chapter 6: Conclusion and recommendations

In this chapter, the findings are summarised in the concluding remarks on theoretical and empirical findings of this research. This chapter also includes a summary of the contribution of this study to the existing body of knowledge on the determinants of liquidity. This chapter also highlights the shortcomings of this study and provides recommendations for future research.

1.7 CHAPTER CONCLUSION

This chapter presented an introductory background on the research study, as well as the objectives of the study and the structure of the thesis.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will focus on the literature review, which was conducted in order to create the framework as planned. The chapter will focus on the main variables, as well as the theory behind the determinants of bank liquidity, which were investigated by other authors. It will also involve analysing and discussing findings of other researchers in journals, researchers' reports, textbooks, and other publications on internal and external factors affecting bank liquidity and the gap that exists as recorded in past literature.

2.2 DEFINITION OF THE MAIN VARIABLES

2.2.1 Liquidity

Several authors have different definitions for liquidity and these are quoted below. Mugenyah (2015) says that the BIS (2008) defines liquidity as the ability to build up enough assets and meet liability obligations as they come due, without suffering losses. Nikolaou and Drehmann (2009) define liquidity as the unimpeded flows within agents of a financial system. These agents are the central bank, commercial banks and markets. Moore (2009) defines liquidity as a financial institution's ability to translate assets into cash without disturbing any of its operations. Bervas (2006: 64) describes liquidity as a range of characteristics rather than as a one-dimensional attribute of assets and of the markets on which these assets are traded. It is also a relative concept, as the more liquid the asset, the more easily it is traded for liquidity (i.e. at low cost, at short notice and with no risk of a notable change in price [see Bervas, 2006]). The two dimensions are funding liquidity and market liquidity (see Bervas, 2006) and they are discussed in depth below (see 2.2.3 and 2.2.4).

2.2.2 Bank liquidity creation

According to Diamond and Rajan (1999: 1), banks undertake activities on either side of the balance sheet. On the asset side, banks extend loans to risky, illiquid borrowers, and on the liabilities side, banks act as liquidity suppliers to depositors. In essence, banks convert illiquid assets (loans) into liquid liabilities (deposits) Diamond & Rajan

(1999). This process is referred to as liquidity creation (see Berger & Bouwman, 2012; Diamond, 2007) and this is important, as it allows for the flow of credit within the economy (Diamond & Rajan, 1999). Banks therefore play an integral part in the economy by facilitating these activities.

According to Sambaza (2016), banks manage risks on behalf of depositors through prudential risk management practices, ethical conduct, good governance and adhering to the covenants of regulators. Availability of sufficient liquidity enables banks to maintain public confidence in the financial system, thereby encouraging saving Furthermore, banks also create liquidity off their balance sheet by committing to provide loans and similar claims to liquid funds (Berger & Bouwman, 2009). In a study conducted by Moore (2009), it was highlighted that in order for a bank to satisfy the financial requirements of its clients, it needs to hold liquid assets. Liquid assets are assets that can be converted into cash very quickly and enable a bank to handle liquidity risk and assist them in managing liquidity and other related risks (Calomiris, Hieder & Hoerova, 2015). Should the bank not have sufficient liquid assets, it either has to borrow from the interbank lending market or from the central bank. This process is also considered a form of liquidity creation (Calomiris et al., 2015).

Choon et al. (2013) further highlight that banks have several sources that they can use in order to fulfil their short-term cash requirements, such as short-term repurchase transactions, which are a form of short-term borrowing, where the bank sells government securities to underlying counterparties, and then buys them back. Such transactions have a tenure of between 1 and 7 days. Strahan (2008: 2) highlights another mechanism or activity that banks use to create liquidity, namely securitisation. This activity involves the conversion of illiquid assets (i.e. credit cards, and mortgage loans) to loans by pooling the illiquid assets together and selling them in the securitisation market. It is also highlighted by Strahan (2008: 1) that banks create other forms of liquidity (i.e. funding and market liquidity) during their activities of liquidity creation. Firstly, the funding of liquid deposits by the creation of illiquid loans constitutes the creation of funding liquidity. This activity involves a bank availing a credit limit to an enterprise or a bank allowing a client to withdraw funds from his or her deposit (Strahan, 2008). The part played by banks (primarily investment banks) in facilitating derivative trades with underlying counterparties, constitutes market funding.

Such derivative transactions entail the bank entering into derivate trades (forward-rate agreements, interest rate swaps, currency swaps) with underlying counterparties and managing the market risk under these trades by calling or placing collateral (which collateral is in a form of cash, equity or bonds) and the process constitutes liquidity creation (Strahan, 2008). Liquidity creation can take two forms, namely funding or market liquidity (Strahan, 2008). These two forms are defined in detail below.

2.2.3 Funding liquidity

Several authors (such as Strahan, 2008 and Brunnermeier & Pedersen, 2008) have expounded on the definition of funding liquidity. Strahan (2008: 1) defines funding liquidity as the raising of cash by an entity or a financial institution on short notice. From a different perspective, Brunnermeier and Pedersen (2008) define funding liquidity as the capability of traders in the derivatives market to raise cash by utilising securities as collateral. This concept is commonly used by banks and other financial institutions when trading derivatives with an underlying counterparty, where the bank or financial institution enters into a derivative transaction with a particular counterparty and banks accept cash, equity or bonds as collateral to settle the margin call on the particular derivative trade (Brunnermeier & Pederson, 2008). The description of funding liquidity by Farag, Harland and Nixon (2013) is in line with t the definition of funding liquidity provided by (Brunnermeier & Pederson, 2008), describing funding liquidity as a situation where a bank has adequate cash or collateral to place with counterparties and clients, as and when they make collateral calls. Drehmann and Nikolaou (2009) define funding liquidity as the bank's capability to settle obligations immediately when they fall due. Bonner, Van Lelyveld and Zymek (2013: 4) use the concept of a financial agent and describe funding liquidity as the agent's capacity to meet financial commitments as they fall due. These authors further elaborate that funding liquidity is binary, in that any financial instrument will at some stage either be liquid or not. Lastly, Gomes and Khan (2011: 37) define funding liquidity as the capability of a firm to generate cash by spreading its assets on its balance sheet to ensure that they meet the firm's short-term liabilities. A bank's liquidity position is determined by how much cash and cash equivalents are at its disposal as well as by its funding is organised and management as well as the amount of contingent liabilities that may come due in the future (Gomes & Khan, 2011).

In summary, funding liquidity is created when a bank has ample funds or cash to settle contingent liabilities by not using traditional client deposits.

2.2.4 Market liquidity

Several authors (such as Strahan, 2008, Gomes & Khan, 2011 and Bervas, 2006) have also expounded on the definition of market liquidity. Strahan (2008: 3) defines market funding as the cost of selling assets, which relates to costs associated with the disposal of an asset in the market. Gomes and Khan (2011) define market liquidity as the capability of an intermediary to transact in financial markets without causing great movement in the price of an asset. Bervas (2006: 64–65) defines market liquidity as the capability to honour transactions at current prices without incurring transaction costs and without being ensured totally. Market liquidity risk arises when there is an inability to raise liquid funds by offloading assets or borrowing, which results from the fact that markets are perfect at all times and in all segments. In their definition of market liquidity, the BIS (2008) considers the dimensions that market liquidity has, i.e. proximity, size, gravity and buoyancy, which relate to the dimensions elaborated on by Bervas (2006: 65), namely tightness, depth and resilience. Tightness is measured with the bid or ask spread of an asset, which is defined at the cost of a reversal of position (from short into long, or vice versa) at a short notice for a standard amount. Market depth is measured by the size of transaction required to change the price of an asset and market resilience is the speed of the prices to return to the equilibrium after a shock in the market (Bervas, 2006) (see Figure 2.1).

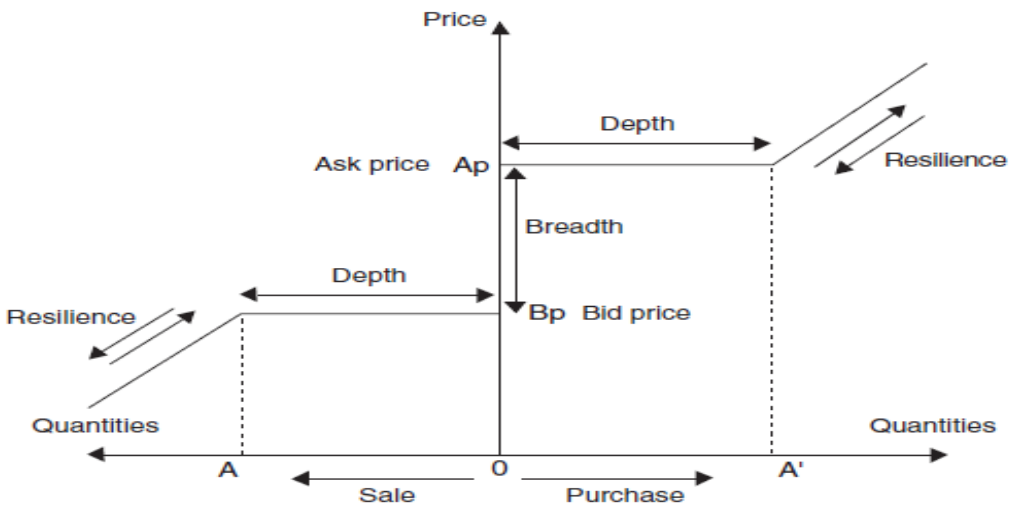

Figure 2.1: Aspects of market liquidity

Source: Bervas (2006)

In summary, it can be concluded that a bank's liquidity risk is driven by the possibility that it might not be able to meet its future financial obligations or have funding liquidity, or the bank's ability to be able to raise funding or assets in order to meet its financial obligations (market liquidity). Tesfaye (2012) concluded that, if an institution does not have enough liquidity to settle its liabilities, it is illiquid. Illiquidity forms part of the liquidity risk, which is defined below.

2.2.5 Liquidity risk

During the process of creating liquidity using both sides of its balance sheet, when a bank issues loans on the one hand and raises deposits on the other hand, it can encounter inconsistencies in that depositors may require funds during a time when these are not available, and this can result in an acceleration to force the liquidation of illiquid assets, as these assets become undervalued when compared to their true market value (Diamond & Rajan, 1999). This process may lead to a bank run due to the bank not having sufficient liquid assets to supply the demand, which can bring bank activities to a halt, thus raising the likelihood of liquidity risk (Diamond & Rajan, 1999). In simple terms, liquidity risk refers to the mismatch of assets and liabilities. Liquidity risk can be measured by two widely known mechanisms (i.e. the liquidity gap approach [see Von Wyss, 2004] or the liquidity ratio approach [see Saunders & Cornet, 2006]). According to Choon et al. (2013: 15), the liquidity gap approach adapts the variation between assets and liabilities both currently and in future periods. A liquidity gap is represented by deficit and a positive liquidity gap requires liabilities to be increased. Bessis (2010) highlights that the liquidity gap treats liquid reserves as a reservoir; the bank takes stock of the liquidity requirement by measuring account inflows and outflows over a specified period.

The liquidity ratio approach uses various ratios to measure liquidity and these ratios are calculated using data from the bank's balance sheet. Vodova (2011) cites the following ratios in his studies:

1. liquid assets to total assets;
2. liquid assets to deposits;
3. short-term financing, loans to total assets; and

4. Loans to deposits and short-term borrowings).

For the purposes of this study, these were the ratios that were used.

2.2.6 Liquidity management by banks

According to Olagunju and Olabode (2011), liquidity management speaks of the planning and control necessary to ensure that the organisation maintains enough liquid assets to ensure that it honours its clients' obligations, which arise from its normal business course or to comply with the regulatory requirements of the central bank. According to Nwaezeaku (2006), bank liquidity management is measured by the availability of cash and the rate at which current assets are transformed into cash to honour unusual requests. For a commercial bank to plan for or manage its liquidity position, it has to meet its legal requirement as a priority. It is of paramount importance for banks to avoid excesses or deficiencies of the stipulated minimum liquidity reserves requirement. Commercial banks are expected to maintain certain levels of reserves (Olagunju & Olabode, 2011) and these reserves are statutory requirements stipulated by the central bank specifying the cash reserves equal to a certain fraction of the bank's deposits or loans and advances, which the bank must maintain (Olagunje and Olabode, 2011). The way a bank's balance sheet is structured is reflective of a bank's liquidity management. Banks have different ways to manage their liquidity based on the make-up of the clients, which impacts the structure of their balance sheet. Certain banks are focused on both retail and wholesale clients and others only have retail clients (Chaplin, Emblow, and Michael (2000).

2.2.7 Determinants of bank liquidity – internal factors

This section will highlight the determinants of bank liquidity which relate to the bank's internal factors.

2.2.7.1 Capital adequacy of bank and bank liquidity

According to Farag et al. (2013: 204), capital represents the bank's own funds, comprising of Shareholders' capital and retained earnings. Capital can also be regarded as the bank's own funds, rather than borrowed money, such as deposits. When added up, own funds are equivalent to the difference between the value of total

assets and liabilities (Farag et al., 2013). The most critical distinguishing factors of capital are that it represents a bank's ability to absorb losses, while the bank remains a going concern, and it is perpetual. As long as the bank continues its business, it is not obliged to repay the original investment to capital investors (Farag et al. (2013). Another view point is that capital adequacy ratio is an indication of the banks susceptibility to withstand losses and this also indicates the resilience to withstand adverse events (Ongore and Kasu, 2013). In essence, if a bank has a high capital ratio than the regulatory minimum requirement, this allows the bank to create liquidity, according to Berger and Bouwman (2009).

2.2.7.2 Size of bank and bank liquidity

Tesfaye (2012: 46) defines the size of the bank as the bank's general capacity to undertake its intermediary function. According to Choon et al. (2013:20), bank size is the measure of its total asset base. In the banking fraternity, the expression 'too big to fail' is associated with big banks, engaging in higher risk activities, with the expectation that the regulators will bail them out, or such bank being availed liquidity assistance by the lender of last resort (Tesfaye., 2012), which results in liquidity creation varying from bank to bank, based on their size, and highlights the positive and negative relationship between bank size and liquidity. Liquidity ratios increase per bank size; however, they decrease after a certain level of bank size (Delechat, Henao, Muthoora & Vtyurina*,* 2012). This positive relationship between the size of the bank and liquidity is also discussed by Hackethal, Rauch, Steffen and Tyrell (2010) and Berger and Bouwman (2009), namely that smaller banks focus on the intermediation processes and transformation activities, which lead to smaller amounts of liquidity. On the other hand, Kashyap, Rajan and Stein (2002) confirm that small banks tend to be more liquid than big banks because they have trouble tapping into the capital markets, thus implying a negative relationship between the size of the bank and liquidity.

2.2.7.3 Loan growth and bank liquidity

Zemel (2012) explains bank loan growth as the expansion or contraction of the loan portfolio of such bank. Loans are the bank's main investment and they are instrumental in the determination of the bank's future cash flows. Growth in the number of loans granted by the bank signals a new set of investments made by the bank and this

means an increase in illiquid assets coupled with a decrease in liquid assets (Tesfaye, 2012). According to Zemel (2012), bank loan growth could signal either good news or bad news. Some banks grant new loans because they have identified new investment opportunities, and for these banks, new loan growth carries positive signals to the capital markets (Zemel, 2012). Other banks grant loans to cover up for losses made in their current loan portfolios. The new loan is granted to salvage a current loan that has gone bad, and for these banks, loan growth is bad news (Zemel, 2012). Cornett, McNutt, Strahan and Tehranian (2010) highlight the relationship between loan growth and bank liquidity. Banks with large illiquid asset portfolios (i.e. banks that hold more loans and securitised assets than liquid assets) increase their holdings of liquid assets and decreased lending, which relates to a positive relationship between loan growth and bank liquidity (Cornett et al., 2010). Banks that possess off-balance sheet liquidity risk in the form of undrawn loan commitments appear as borrowers draw on previously approved loan facilities in large quantities, display lending capacity and constrain new credit origination, thus showing that there is a negative relationship between loan growth and bank liquidity (Cornett et al., 2010).

2.2.7.4 Non-performing loans and bank liquidity

Tesfaye (2012: 2) describes non-performing loans as loans that are outstanding in both principal and interest for a lengthy period, conflicting with the initial terms and conditions stipulated in the loan agreement, which reflects the bank's loan book quality. Another description by Zemel (2012) refers to non-performing loans, as loans that are expected to translate to future losses for the banks. Bloem and Gorter (2001) state that if a bank has a high number of non-performing loans, leading to a reduction in the bank's ability to extend credit further, it results in a liquidity crunch and prejudicing other creditors that are in good standing. This eventually leads to investors and depositors withdrawing their funds, thus pushing the bank into a liquidity crisis. This, then, confirms that there is a negative relationship between non-performing loans and bank liquidity.

2.2.8 Determinants of bank liquidity – external factors

This section will focus on the external factors that are determinants of bank liquidity.

2.2.8.1 Inflation and bank liquidity

Inflation is the increase in the general price of goods and services over a period of time in an economy (Tucker, 2007). Inflation causes a lot of discomfort within the economy, especially to retirees who are living off their pension. The constant rise in prices of goods and services reduces the consumer's ability to purchase, and also affects some highly indebted consumers, resulting in loan repayment inability (Audo (2014). Inflation also has the ability to influence the liquidity status of a bank and it can have detrimental impact on interest rates and the bank's capital thereby resulting in the deterioration of collateral security values and an expansion of the bank's non-performing loans (Sambaza, 2016).

2.2.8.2 GDP growth and bank liquidity

GDP growth is a measure of total economic activity in an economy (Mugomba, Sharara, Chikwawa & Mushayi, 2013). According to Aspachs, Nier and Tiesset (2005), during an economic downturn, banks tend to place emphasis on liquidity by restricted lending, and they neglect liquidity during an economic boom, when the climate is conducive to lending. This confirms that there is a negative relationship between liquidity and GDP growth (see Sambaza, 2016 and Tesfaye, 2012).

2.3 REVIEW OF RELATED THEORIES

This section will focus on theories relating to liquidity and liquidity creation.

2.4 Liquidity creation and financial fragility: theory

A number of authors, namely Diamond and Rajan (2001), Bryant (1980), Diamond and Rajan (1999), Tesfaye (2012), Berger and Bouwman (2009) and Hackethal et al. (2010) agree on one fact, namely that the fundamental role of banks within the economy is to create liquidity by funding illiquid loans with liquid demand deposits. Using this function of providing liquidity, banks hold illiquid assets and provide cash and demand deposits to the rest of the economy, according to Tesfaye (2012).

Farag et al. (2013: 202) explain the function of banks not only as creators of liquidity but also numerous other roles that banks perform, such as –

- providing households with transactional ability, allowing them to settle transactions;
- extending credit facilities to the players in the economy, e.g. by offering home loans to households and term loans to corporates; and
- helping individuals and corporates to manage various risks encountered globally, such as offering depositors access to their current accounts on demand, as well as providing them with derivative products and other finance-related services.

Banks create liquidity by accepting deposits from clients and channelling them to clients who need them (Moore, 2009). Banks, like any other corporate, need to fund their activities and can do so by using a combination of borrowed funds (liabilities) and their own funds (capital). Liabilities can be in the form of retail deposits from individuals and corporates, wholesale funding (funds borrowed from the institutional market, i.e. pension funds) as well as interbank borrowings. Banks also have another way of creating liquidity by borrowing from the central bank, namely the lender of last resort (Aspachs et al., 2005).

The fundamental function of creating liquidity by banks is also highlighted by Kashyap, Rajan and Stein (2002: 33), who note that commercial banks engage in two diverse types of activities, which are reflected on either side of the balance sheet, namely deposit-taking and lending. Deposit-taking involves issuances that are less risky and payable on demand, which can be exchanged for an amount at a given time (see Diamond & Dybvig, 1983). Lending is the sourcing of valuable, but dense information about borrowers and offering them credit based on the density of the information provided about them (see Ivashina & Scharfstein, 2010). Although the present study reports on how commercial banks create liquidity by taking in deposits and at the same time performing lending, the study, however, did not investigate the importance of both these activities being housed by one institution. The study however noted that the usage of deposit insurance by banks, where banks normally maximise the value of the insurance put option (see Saunders & Thomas, 1997) by engaging in risky lending, clouds the reason why these two activities can or cannot be housed under the same roof.

Having deposit-taking and lending activities that take place under one roof could expose banks to financial fragility, in that they make loans available that cannot be converted into cash without incurring high costs (Kashyap et al., 2002). On the other hand, banks issue demand deposits, which allow depositors to have access to them at any given time. This liquidity mismatch, where the bank's liabilities are more liquid than its assets, has the potential to create a problem for banks, when too many depositors attempt to withdraw at once, called bank runs (see Diamond, 2007). However, bank runs can be circumvented by arranging insurance in which depositors share the risk of liquidating an asset early at a loss (Diamond & Rajan, 2001: 190). A study by Kashyap et al. (2002: 34) focused on the question whether or not there is real synergy for a bank being a deposit-taking and a lending institute at the same time. This study argued that if there are no synergies for banks engaging in both activities, one would deduce that these activities resulted from either past or present alterations in the regulatory environment (i.e. the usage of deposit insurance being to circumvent bank runs, while undertaking risky lending practices [see Saunders & Thomas, 1997]). The other side of the argument is that if there are real synergies for a bank to undertake both activities, this might have been the result of a forced switch to narrow banking (see Saunders & Thomas, 1997), which could lead to massive inadequacies. This study, however, focused on the argument that there may be significant synergies between deposit-taking and lending. Furthermore, the study focused on the product that differentiates banks from other lenders, such as insurers and finance companies. The researcher noted that having a committed loan in place is as good as having a demand deposit, because the borrower could draw down on it over a specified time frame, which is similar to a demand deposit through which the client can withdraw funds at any random time. These two scenarios are equated to the provision of liquidity on demand to cover unforeseen circumstances.

In addition to the fundamental activity of banks to create liquidity, by their study, Berger and Bouwman (2009) also contributed some insight into the potential effects of capital on liquidity creation. The study raised the question as to why banks that have the lowest capital ratios of any industry create financial fragility. The financial fragility of non-systemic banks created by too-big-to-fail guarantees to systemic banks can be mitigated by a high deposit insurance limit. This raises the question as to what can be

done about the non-trivial moral hazard costs associated with deposit insurance (Egan, Hortascu & Matvos, 2017).

2.4.1 Liquidity preference theory

The liquidity preference theory was promulgated by Lord Keynes in 1936. Since its publication, several authors, such as Davidson and Kregel (1999) and Ogiriki and Andabai (2014), have summarised this theory. In the present study, the summaries of these authors have been used in the definition and explanation of this theory.

According to Davidson (1991), money is the most liquid asset of an economy, and is used by entrepreneurs. The majority of the money supply comes directly from banks (i.e. the bank's own liabilities and demand deposits). The bank liquidity preference approach (see Tobin, 1956) suggests that banks are always striving for active balance sheet policies instead of actively thriving to grow demand for credit.

Keynes (1936) defines the liquidity preference theory as the compensation for not holding on to liquidity but for parting with liquidity for a specified period (Ogiriki & Andabai, 2014). The liquidity preference theory states that money is often required for one or all of the following:

- Firstly as a transaction motive, which involves day-to-day transactions performed by both individuals and organisations and which require some cash to be retained, called the demand for liquidity for transaction motive (see Acharya & Merrouche, 2012). This demand is dependent on the size of the income, and the time gap between the receipts of income and spending habit, when there is a capital expenditure project for finance.
- Secondly as a speculative motive, which involves holding on to cash to take advantage of future changes in interest rates or bond prices (see Rezende, 2015).
- Thirdly as a precautionary motive, which involves the retention of money to cover unforeseen circumstances (see Baumol, 1952).

According to Okpara (2010), the total demand for money combines the speculative motive with the transaction and precautionary motives, and is denoted by **M1,** which

is a function of normal income. The part that is held for speculative purposes is called **M2**, which is dependent on the market rate of interest.

In addition to the motives noted above, Ogiriki and Andabai (2014) highlights two important factors that relate to this theory (i.e. the liquidity preference theory, namely the supply of money and the desire of savers to hold their savings in cash and near cash. This theory symbolises the monetary theory of interest (see x`, 2010) as dissimilar from the real theory of the classical school of thought (see Keynes, 1936e).

The supply of money addresses the overall measure of money in a country, and money is supplied by the central government (Sealey & Lindley, 1977).

Contrary to the summary above, BIBOW (2005) states that an alternative theory to the Keynesian theory is liquidity preference (see Keynes, 1936) as a theory of asset choice between holding idle money and holding loans, with the role of interest rate being that of bringing everything alike to the attractions of both. Interest rate is the benefit of foregoing liquidity in a world where there are only two asset classes, namely short-term liquid capital-risk free assets (money) or long-term illiquid assets (bonds) (Keynes, 1936). Furthermore, according to Bibow (2005), Keynes depicts the four factors of the liquidity preference theory as –

- the generation of incomes to the owner (profits, interest rates, dividends and rent) symbolised by (q);
- the carrying costs (c);
- liquidity premium (l); and lastly
- appreciation or depreciation of his or her market value (a).

We can, therefore, express each asset class according to its own rate of interest in the following equation:

$$a + q - c + l$$

At any given time, assets with higher-than-average interest rates would be subject to heftier demand and their current market prices would increase, while the assets with inferior or lower-than-average interest rates would not be demanded and their market prices decrease (Berger & Bouwman, 2009). In an equilibrium state, asset prices

would be used to the rates of return. In equilibrium, such asset prices would possess steady returns (Tsiang, 1956). Assets, like money and bonds, only have a single risk of capital losses, on the back of increasing interest rates. In this instance, the liquidity preference model would reflect a spin-off between financial returns as follows ($a + q - c$) and the liquidity premium of money (l) (Tobin, 1961

The sum of money restrained for contract equals a percentage of excess of the rate of interest. Every kind of asset is linked to a rate of interest of money. The fact that the own rate of interest of money is stated, makes this very peculiar.

Furthermore, Davidson and Kregel (1999) highlight that some economists have utilised a combination of Robinsonian and Kaldorian (see Lavoie, 2014) strands to present a model where speculation problems are canned within a model of capital accumulation (see Lavoie, 2014). This has proved that the liquidity preference theory (see Keynes, 1936) is a theory of portfolio choice instead of just a single asset choice.

2.4.2 Liquidity preference of banks

According to Davidson and Kregel (1999), the liquidity preference of banks refers to a choice between a representative of earning assets, loans, liquid assets and monetary reserves. These models ideally take the form of the amount of deposits made at the bank as given. Out of the amount of deposits that a bank raises, the bank has to choose between reserves (R) and loans (L), which are rewarded by interest rate (r), with the value of outflow of deposits (X), and probability f(X). The cost of an eventual deficiency of reserves is the penalty rate (p). In order to avoid this penalty, the bank creates reserves at the cost of rR and if the banks decide to lend, its losses are given by following equation (Keynes, 1936):

$$p(X - R)F(X)DX$$

In order to utilise this equation optimally, one has to divide its resources between loans and reserves in the proportion that is determined by the condition as reflected in the following equation:

$$r = p\, f(X)dx$$

In Davidson and Kregel (1999), following the Keynesian approach (see Keynes, 1936), the contrast between reserves vs loans is an inadequate starting point for two reasons. Firstly, empirically, the accumulation of reserves does not seem to be or have been the way in which liquidity needs are satisfied. The easier and simple way is to save in exceptional circumstances. All banks use their reserves to the fullest, and they never maintain idle reserves in excess of what is their conventional or legal proportion of the time being. However, American banks accumulated excess reserves during the Great Depression (1930 1933, which is a phenomenon known as the absolute liquidity preference) (see Keynes, 1936). Secondly, banks face a dilemma not of how much to lend, but which proportion of its reserves can be conveniently and carefully lent out in relation to the less risky assets (Whalen, 1966).

In the dilemma faced by banks, they always try and divide their resources between different types of investments (assets). These assets are divided into three categories (i.e. bills of exchange and call loans to money market, investments, and advances to clients) (Baumol, 1952).

Advances to clients are considered the favourite choice due to their profitability over investments, and investments are more profitable than bills and call loans. On the other hand, bills of exchange and call loans are more liquid (retrievable within 12 months) than investments, and investments are more liquid than loans and advances demand deposits are regarded as liabilities (Davidson & Kregel, 1999). These liabilities are refinanced daily by ensuring that clients are offered lucrative terms.

2.4.3 Liquid assets in banks

Alger and Alger (1999) highlight that the two main activities of a bank are to accept deposits from clients who have excess liquidity, and to extend loans to clients who are in need of liquidity. However, a bank may not invest all its available liquidity (loans) and may retain some of its liquidity (mainly cash and reserves at the central bank) or invest them in marketable securities, such as treasury bills or bonds. The difference between these instruments and loans is that these instruments are more liquid (Alger & Alger, 1999). There is an opportunity cost in investing in more liquid assets as they yield low returns.

The aforementioned authors have raised the question of why do banks hold liquid assets since returns on more liquid assets are very low. In the authors' response to this question, the authors reviewed existing theories on bank liquidity and have come up with four broad categories, namely:

1) The portfolio management theory, where risk aversion is the integral drive of explaining liquid assets of a bank (see Alger & Alger, 1999).
2) The theory of demand and supply, which view liquid assets as the residual between the bank's equity and liabilities and the credit portfolio (see Alger & Alger, 1999). (These first two theories do not take into account liquidity shocks [see Alger & Alger, 1999]).
3) Liquid assets as a buffer theory (see Alger & Alger, 1999), which explains why banks would want to keep liquid assets that would enable them to withstand severe liquidity shocks.
4) Liquid assets and liabilities – the role of imperfections, which explains the extent to which banks can rely on increased liabilities to fund liquidity on short notice (Maksimovic, 1990).

The abovementioned theories are summarised below.

2.4.3.1 Portfolio management theory

As previously mentioned by Choon et al. (2013), banks have several sources that they can use in order to fulfil their short-term cash requirements, which among others include short-term repurchase transactions, in the form of short-term borrowing, where the bank sells government securities to underlying counterparties, and then buys them back, which transactions have a tenure of between one and seven days. These short-term transactions are also known as securities (See Kusy & Ziemba, 1986).

In explaining this theory, Alger and Alger (1999: 3) adapted a model that was used by Freixas and Rochet (1997). This model considers a risky financial security (i.e. loans) and a risk-free security (liquid asset). The portfolio management theory confirms that if deposits and equity are also interpreted as securities, then the size of the bank is indeterminate (see Alger & Alger, 1999e). This is derived from the fact that any multiple of the portfolio of securities, which is optimal for a given level of equity and deposits,

is also optimal. In the event of the size being a random variable, the proportion of liquid assets to total assets should be independent of size (Zarruk & Madura,1992).

2.4.3.2 Liquid assets as residual: the role of supply and demand

The portfolio management theory of banking (see Alger & Alger, 1999) mentioned above assumes that the bank manager is risk-averse. This assumption is relative to a small bank, but to a bank that has shareholders who have diversified investment portfolios, risk objectivity prevails (Freixas & Rochet, 1997).

In dealing with the question of why banks hold liquid assets if the returns on these are low, Alger and Alger (1999: 5) view liquid assets as the differential between equity plus deposits and credits in terms of supply and demand, which contradicts the portfolio management theory. However, in this theory, banks sell credit using deposits as their source. When a bank accepts deposits, it incurs certain related charges, which are summarised into separate charges (Diamond & Rajan, 2001). In the event of the demand for credit and supply of deposits being exogenously given functions, then standard marginal charges equal to the marginal revenue rule will be the pragmatic approach to determine the amounts of credit supplied and deposits demanded by the bank. In a given market structure, differences in what the balance sheet contains can be traced to differences in the charges functions (Maksimovic, 1990).

The liquid assets as residual theory states that, in a typical recession scenario, liquid assets held by banks (which are determined by the level of deposits) should increase if the population of borrowers is believed to have become more risky (see Saretto & Tookes, 2013).

2.4.3.3 Liquid assets as a buffer theory

The previously mentioned theories (i.e. the portfolio management theory and the liquid asset as a residual theory) do not take into account the possibility of deposit runs or other events that may affect inflow and outflow of funds in a bank. Alger and Alger (1999: 6–7) used a theory in which banks invest in liquid assets for precautionary motives. The one outcome that was observed in this theory was that banks with relatively more demand deposits should hold relatively more liquid assets

(representing an increase in demand deposits corresponding to a shift in the shock distribution) (Alger, 1999).

2.4.3.4 Liquid assets and liabilities: the role of market imperfections

According to Alger and Alger (1999: 8), the liquid assets and liabilities theory does not openly model the liability side of a bank's balance sheet as a liquid source but only indirectly through the penalty rate. The penalty rate is the rate, which is independent of the amount required and the cost increasing liabilities, which are available on an unrestricted basis. In their study, Alger and Alger (1999: 8) took into account a study done by Poole (1968) and another by Holmström and Tirole (1998). These studies focused on banks that encountered problems when raising external finance due to the moral hazard (where banks cannot pledge the full value of an investment project to outside investors). Banks make long-term investments. During liquidity shocks, banks may require liquidity, which might not be forthcoming from investors due to the amount being insignificant to the bank or just not economically viable. Banks can, however, avert this situation by investing in liquid assets to ensure that these assets are available when required, thus eradicating the need to call on investors at crucial times. It was then summarised that when the distribution of the liquidity shock is riskier (i.e. when large shocks become the norm), the amount of liquid assets is larger (Poole (1968) However, when the distribution of the liquidity shock is riskier (a mean preserving spread), the optimal amount of liquid assets decreases (Holmström & Tirole, 1998). Furthermore, it can be deduced that when the distribution is riskier (on the margin of the investment in liquid assets) this implies a lower increment of insurance. The bank buys less protection and instead invests in illiquid assets (Alger & Alger, 1999: 8).

In conclusion, the authors Poole (1968) and Holmström and Tirole (1998), note that deposits are more effective liquidity hedges for investors than investments in bank equity capital; thus, higher capital ratios shift investors' funds from relatively liquid bank deposits to relatively illiquid bank capital, reducing overall liquidity for investors (Berger & Bouwman, 2009: 7).

2.5 CHAPTER CONCLUSION

In this chapter, theories on why banks hold liquidity buffers as part of their balance sheet was expounded on and were applicable to the general banking industry. However, this chapter highlighted the complex nature of s of liquidity. By far, the portfolio management theory, covered both sides of liquidity, which is assets and liabilities.

CHAPTER 3: DETERMINANTS OF COMMERCIAL BANK LIQUIDITY: EMPIRICAL STUDIES

3.1 INTRODUCTION

This chapter covers empirical studies conducted by several authors on the determinants of commercial bank liquidity around the globe and highlight the results thereof. The next section reflects the empirical review using quantitative analyses of theories on studies conducted by different authors in South and Latin America, Central America, the United States of America, Europe, Asia and Africa on the relationship between bank liquidity and banks' internal and external factors.

The next section discusses empirical studies conducted in South and Latin America and Central America.

3.2 EMPIRICAL STUDIES CONDUCTED IN SOUTH AND LATIN AMERICA AND CENTRAL AMERICA

This section focuses on empirical studies conducted by several authors (Moore, 2009; Delechat et al., 2012) in South and Latin America and Central America.

A study by Moore (2009) had as its objectives to –

- discuss the behaviour of commercial bank liquidity during crises in Latin America and the Caribbean;
- identify the key determinants of liquidity; and
- provide an assessment of whether commercial bank liquidity during crises was higher or lower than what is consistent with economic fundamentals.

In order to achieve these results, Moore (2009) conducted a descriptive analysis of the liquidity indicators before, during and after the global credit crisis for 16 Latin American and Caribbean countries, over the period 1980 to 2002. The results revealed that the loan-to-deposit ratio increased during the banking crisis by about seven percentage points, suggesting that liquidity generally contracts during a credit crisis, as commercial banks are swamped with numerous requests for deposit withdrawals. In countries like Argentina and Chile, the liquidity ratio rises during extreme downturns, by more than 33 percentage points relative to 18 months prior to the credit crisis

(Moore, 2009). In some of the countries, the loan-to-deposit ratio deteriorated, indicating an increase in commercial bank liquidity, due to the following factors. In some countries, government purchased and recapitalised a number of banks that probably would have failed. In countries with high foreign bank concentration, those foreign banks received liquidity support from their foreign parents, and multiple crisis periods did not have a bearing on financial development (Moore, 2009).

However, contrary to the above, in all cases, except in Peru, where the banking crisis was modest, liquidity expanded in the 18 months after the crisis. The average loan-to-deposit ratio fell by 17 percentage points after the crisis mainly due to various government bodies implementing financial sector reforms that brought about intervention (Moore, 2009: 9).

Moore (2009) used a regression model to derive the determinants of commercial bank liquidity. The results revealed that, in half of the countries studied, liquidity was inversely related to the business, suggesting that commercial banks tend to make a mistake on the side of caution by holding excess reserves during downturns. Although this could be considered as low risk, in relation to the number of industry defaults, it could increase the chances of recession, due to a reduction in the provision of credit-decreasing investment and thus threatening the ability of the economy to emerge from a cyclical downturn (see Moore, 2009). Furthermore, the volatility of income was not properly taken into account in nine out of the 16 countries examined (Moore, 2009). An increase in the interest rate (which presented a disincentive for holding liquidity), was positively and significantly related to liquidity in some countries.

However, the coefficient on this variable was negative and significant in some countries, suggesting that increasing interest rates have an enormous bearing on the supply of deposits relative to the supply of loans. This was evident in countries with relatively high interest rates, such as Brazil, Chile, Ecuador, El Salvador, Jamaica, Uruguay and Venezuela (Moore, 2009).

In summary, the following was observed from Moore (2009) study:

- liquidity was inversely related to the business in half of the countries studied;
- an increase in the interest rates was positively and significantly related to liquidity; and

- the volatility of the cash-to-deposit ratio was negatively related to liquidity, suggesting that commercial banks were generous with liquidity when there was an increase in the volatility of cash demanded by the public (Moore, 2009: 13).

3.3 EMPIRICAL STUDIES CONDUCTED IN CENTRAL AMERICA

The empirical studies reflected in the section below focused on the determinants of commercial bank liquidity buffers in Central America, with specific focus on Central America, Panama and the Dominican Republic (CAPDR), using a sample of 96 commercial banks over the period 2006 to 2010. The majority of these countries used the dollar as their currency. Delechat et al. (2012) used the liquid-assets-to-deposits ratio as their measurement of the liquidity buffer and aligned their study with studies previously conducted by Aspachs et al. (2005). Using the generalised methods of moments regression model (see Bond, 2002), certain baseline results were found.

Banks in CAPDR had levels of liquidity buffers that were above the legal and prudential requirement, having average liquidity ratios of 25% and these banks were able to withstand deposit volatility (Delechat et al., 2012). Banks that were small in size, which had low capitalisation ratios and were less profitable, held low levels of liquidity buffers. In addition, foreign owned banks were also prone to holding less liquidity than indigenous banks because their foreign parents were in a position to provide them with emergency funding, if the need arose. When the asset quality of a bank deteriorated (i.e. the riskier the bank), the less liquidity the bank held; however, this finding did not apply to foreign banks and banks in highly dollarised economies (Aspachs et al., 2005).

3.4 EMPIRICAL STUDIES CONDUCTED IN THE UNITED STATES OF AMERICA

Bordeleau and Graham (2010) also conducted a study on the effect of liquidity on the profitability of the banks. This study was based on other empirical studies conducted on the determinants of commercial bank liquidity in Canada. The study focused on a group of Canadian and American Banks between 1997 and 2009, using an econometric framework through which the dependent variable, profitability, was regressed against non-linear expression of relative liquid asset holdings as well as a set of control variables (Bordeleau and Graham, 2010).

Bordeleau and Graham (2010) also included macroeconomic factors, such as interest rates, unemployment, inflation and output growth. The results of the study highlight that, at the time of the research, there was a non-linear relationship between profitability and liquid assets. Profitability of banks that held some liquid assets improved; however, holding liquid assets could lead, among other things, to depletion of the profitability of a bank. Other findings were that the relationship that exists between a bank's liquidity and profitability is also dependent on the business model off the bank and the funding market risks of such bank (Bordeleau & Graham, 2010). If a bank funds its loan book traditionally, namely by using client deposits, this models the bank to maximise its profitability metrics, (Ibe, 2013). Similarly, when there is low probability during market volatility, banks can maximise their profits, while holding less liquid assets (Bordeleau & Graham, 2010: 14). These findings are in line with the literature that was consulted, which noted that the opportunity cost of holding low-return assets eventually outweighs the benefit of any increase in bank's liquidity resiliency (see Kosmidou, Tanna & Pasiouras, 2005 and Goddard, Molyneux & Wilson, 2004) Although the following empirical study by (Bonner et al., 2013) did not focus directly on the determinants of commercial bank liquidity; it highlighted that profitability is one of the determinants of commercial bank liquidity, in that there is an existing relationship between liquidity and profitability and profitability is affected by liquidity (Bonner et al., 2013).

The aftermath of the global credit crisis revealed the vulnerability within the banking sector's liquidity risks not connected to banks' capitalisation, which led to a reform of the liquidity framework and the introduction of the short- and long-term liquidity ratios by the BCBS (Bonner et al., 2013: 2). These regulations prompted Bonner et al. 2013 to identify a shortcoming, that little research had been conducted to understand what the basic determinants of banks' incentives to hold liquid assets were and whether these determinants were affected by liquidity regulation. As a basis for their study Bonner et al. 2013 used findings from a study conducted by Aspachs et al. (2005). Bonner et al. (2013) used a group of 7 000 banks within the Organisation for Economic Cooperation and Development (OECD) region, for the period 1998 to 2007, and analysed the data using the ordinary least squares (OLS) regression model (see Craven & Islam, 2011), with liquidity being the dependent variable and others being independent. The study by Bonner et al. (2013) revealed that without liquidity

regulation, bank liquidity buffers are determined by a combination of bank-specific factors (business model, profitability, deposit holdings and size), as well as country-specific factors (disclosure requirements, concentration of the banking sector) (Bonner et al., 2013). The results showed that regulation was above all incentives for banks to hold liquid assets. The results further showed that regulation results in a non-linear relationship between size of the bank and liquidity holdings of the bank, with the largest banks having sizeable holdings (Bonner et al., 2013). The concepts 'disclosure' and 'liquidity requirements' are motivation for regulators of banks to synchronise disclosure and Basel III liquidity requirements (see BIS, 2010)) across countries. However, the size of bank, tends to exaggerate the effect of the size in terms of systemic risks (Bonner et al., 2013).

Furthermore, the interconnectedness of banking sectors globally resulted in the global credit crisis not only affecting America, but banks around the world. As a result, studies on liquidity and on the relationship between liquidity and the bank's internal and external factors were not only conducted in America and South America but globally too. The following section focuses on studies conducted in Europe.

3.5 EMPIRICAL STUDIES CONDUCTED IN EUROPE

Hackethal et al. (2010) conducted a study regarding liquidity creation of 457 German savings banks over the period 1997 to 2006. The authors used two exclusive techniques of measuring liquidity, namely the BB-measure developed by authors Berger and Bouwman in 2009, and the liquidity transformation gap, which was developed by Schaefer in 2004. These two techniques of determining intrinsic amounts of liquidity were created for the German economy as well as to accommodate the mix in the maturity transformation performed by the panel of banks (Hackethal et al., 2010). Using a multivariate dynamic panel regression framework (see Chamberlain, 1982), Hackethal et al. (2010) were able to set apart the possible determinants of bank liquidity, namely the bank's internal characteristics, such as size or business focus as well as the macroeconomic factors (i.e. monetary policy or economic strength indicators) (Hackethal et al., 2010). This study also took into account legal developments in the German banking sector by measuring the effects of the abolishment of state guarantees in the public sector banking sector on liquidity creation (Hackethal et al., 2010). Over the study period, the study found that the total

amount of liquidity created by the savings banks increased by 51.0% (Hackethal et al., 2010). Looking at the effect the factors had on liquidity creation, monetary policy tightness had a negative effect on liquidity creation, in that any monetary policy tightening causes a reduction in the amount of liquidity created (Hackethal et al., 2010). Furthermore, the study did not find any bank-specific factors, such as financial performance or size of a bank, to have any influence on liquidity creation (Hackethal et al., 2010).

After identifying that a gap existed in empirical literature about liquidity and its measure, Vodova (2011) conducted a study on the determinants of Slovak commercial bank liquidity. This study considered bank-specific and macroeconomic factors over the period 2001 to 2010. The data was analysed using panel data regression analysis (see Blundell & Bond, 1998) for four liquidity ratios (i.e. liquid assets to total assets, liquid assets to deposits and short-term borrowing, loans to total assets and loans to deposits and short-term financing (Vodova, 2011)). The results of the study confirmed that bank liquidity dropped mainly as a result of the financial crisis (Vodova, 2011). Banks' liquid assets decreased also with higher bank profitability, higher capital adequacy and with the size of the bank (Vodova, 2011). Liquidity measured by the lending activity of banks increased with the growth of the GDP and bank profitability and decreased with high unemployment (Vodova, 2011). Key interest rates, interest margin, rate of inflation and the level of non-performing loans had no statistically significant effect on the liquidity of Slovak commercial banks (Vodova, 2011).

In 2011, Vodova conducted a study on the determinants of commercial bank liquidity in the Czech Republic, covering the period 2001 to 2009. The data was analysed using panel data regression analysis for four liquidity ratios (i.e. liquid assets to total assets, liquid assets to deposits and short-term borrowing, loans to total assets and loans to deposits and short-term financing). The results of the panel data regression analysis confirmed that commercial bank liquidity is positively related to the capital adequacy of banks, interest rates on loans, share of non-performing loans and interest rates on interbank transactions, and negatively related to inflation rate, business cycle and financial crisis (Vodova, 2011). The influence of the size of banks was ambiguous.

Furthermore, Vodova also conducted a study on the determinants of commercial bank liquidity in Hungary, covering the period 2001 to 2010. The data was analysed using

panel data regression analysis for three liquidity ratios (i.e. liquid assets to total assets, liquid assets to deposits and short-term borrowing, liquid assets to deposits). The results of the panel data regression analysis confirmed that commercial bank liquidity is positively related to capital adequacy of banks, interest rates on loans and bank profitability, and negatively related to the size of the bank, interest margin, monetary policy interest rates and interest rates on interbank transactions. The relationship between the growth rate of GDP and bank liquidity was ambiguous (Vodova, 2013).

Munteanu (2012) studied bank liquidity and its determinants in Romania. The author analysed 27 banks in Romania over the period 2002 to 2010, with specific emphasis on the pre-crisis years (2002 to 2007) and the crisis years (2008 to 2010). The author focused on two liquidity ratios, namely net loans–total assets and liquid assets–deposits and short-term funding (Munteanu, 2012). The data used in Munteanu's study was obtained from Fitch's Bankscope database for bank-specific factors. The liquidity ratios used in this study as well as the results of the regression were consistent with the liquidity ratios used in studies conducted by Vodova (2011; 2013) and Choon et al. (2013). The results of the panel data regression analysis confirmed that commercial bank liquidity is positively related to capital adequacy of banks, non-performing loans and interbank funding (Munteanu, 2012). The next section discusses studies conducted in Asia.

3.6 EMPIRICAL STUDIES CONDUCTED IN ASIA

Further studies regarding liquidity were also conducted in Asia, with some of the findings being in line with findings from Europe.

Choon et al. (2013) studied determinants influencing the liquidity of Malaysian commercial banks, and its implication for relevant bodies. The authors involved 15 Malaysian banks over the period 2003 to 2012, using the fixed-effect model framework (see Allison, 2009) to investigate the effect bank-specific factors (i.e. bank capital, bank size, non-performing loan ratio and profitability) as well as macroeconomic factors (i.e. interbank rate, GDP and financial crisis) have on commercial bank liquidity. The results confirmed that some of the bank-specific factors (i.e. bank capital, bank size, non-performing loan ratio and profitability) as well as two of the three macroeconomic factors (i.e. GDP and financial crisis) have significant effects on the

liquid assets holdings of banks. However, interbank rates had an insignificant effect on banks' liquid assets holdings (Choon et al., 2013: 78).

Subedi and Neupane (2013) studied the determinants of bank liquidity and their influence on the financial performance in Nepalese commercial banks. Subedi and Neupane (2013) focused on six commercial banks, using a primary data collection method in the form of a questionnaire, and a secondary data collection method in the form of statistics from the banks' annual financial statements. A multivariate linear regression model (see Chamberlain, 1982) was used to include liquid-assets-to-total-assets ratio, loan to deposit and short-term financing and return on assets for the data covering the period 2002/2003 to 2011/2012. Based on quantitative methods, hypotheses were tested and conclusions reached. The results of the regression analysis showed that capital adequacy and share of non-performing loans had a negative and statistically significant effect on commercial bank liquidity, whereas loan growth, growth rate of the GDP on the basis of price level, liquidity premium paid by the borrowers and short-term interest rates had a negative and statistically insignificant effect on commercial bank liquidity. Bank size had a positive and a statistically significant effect, and the inflation rate had a positive and insignificant effect on commercial bank liquidity (Subedi & Neupane, 2013). The next section discusses studies conducted in Africa.

3.7 EMPIRICAL STUDIES CONDUCTED IN AFRICA

Studies on liquidity were also conducted in Africa (e.g. Kamau, Erick & Murithi, (2013); Tesfaye, (2012); Sheefeni and Nyambe (2016); Pontes and Murta (2012); Melsese and Laximikantham (2015); Melsese and Laximikantham (2015); Aikaeli (2006); Uremadu (2009); Moussa (2015) and Chagwiza (2014)).

Kamau et al. (2013) studied the factors influencing the liquidity level of commercial banks in Kisumu City, Kenya. The authors investigated all 27 commercial banks operating in Kisumu City, using exploratory survey research due to the nature of the data, which had more than one variable. Factors that were considered were bank ownership and size of banks in terms of assets and number of employees. This study identified factors internal to the bank that had a significant effect on commercial bank liquidity, such as contingency planning, profitability, major obligations of banks and

management policies. External factors that had a significant effect on commercial bank liquidity were credit rating of the country, monetary policy, government expenditure and balance of payment status (Kamau et al., 2013).

Pontes and Murta (2012) studied the demand for excess reserves by the banks in Cape Verde, as well as determinants of excess reserves and the way the demand changed with the beginning and development of the crisis. This study covered the period 2003 to 2009 and used data provided by the Central Bank of Cape Verde (see Pop, 2011). Pontes and Murta used the two-stage least squares method (see Kelejian & Prucha, 1998) in analysing the data. The results revealed that in less-developed countries, such as Cape Verde, there are two types of liquidity determinants, namely precautionary and involuntary liquidity determinants. Precautionary liquidity determinants refer to liquidity balances that are above the minimum requirements needed to meet the withdrawals of deposits and other uncertain payments (Holmström & Tirole, 1998). Balances that are in excess of the precautionary needs are referred to as 'involuntary liquidity determinants. Literature classifies involuntary determinants into structural and cyclical liquidity factors (see Saxegaard, 2006). Structural factors are macroeconomic factors, which refer to a low degree of financial development, a high degree of risk aversion that causes banks to demand a high-risk premium, which lowers private sector credit demand, and a lack of competition in the banking sector, which leads to banks offering weak credit (Saxegaard, 2006). Cyclical factors, on the other hand, comprise huge capital inflows, FDI associated with the liberalisation of capital inflows and/or foreign aid, and a crisis environment, accompanied by a high degree of uncertainty, which causes the accumulation of reserves by banks, which see lending as a risky activity (Saxegaard, 2006).

Tesfaye (2012) conducted an empirical study on the determinants of bank liquidity and their effect on financial performance of 14 commercial banks in Ethiopia. In order to be consistent, Tesfaye used secondary data in the form of annual statements for each bank as well as various journal publications from the Central Bank of Ethiopia (Tesfaye, 2012). The data covered the period 2001 to 2011. A panel data regression model was used to analyse the data. This involved the pooling of observations on the cross-sectional regression model (see Barros & Hirakata, 2003) over several periods. The research identified eight factors that affect bank liquidity, namely capital

adequacy, size of the bank, share of non-performing loans, interest rate margin, inflation rate, short-term interest rate, real GDP growth rate and loan growth. The results of the panel data regression analysis showed that capital adequacy, size of the bank, share of non-performing loans, interest rate margin, inflation rate and short-term interest rates had a positive and statistically significant effect on commercial bank liquidity. Real GDP growth rate and loan growth had a statistically insignificant effect on commercial bank liquidity (Tesfaye, 2012).

Melsese and Laximikantham (2015) studied the determinants of Ethiopian commercial bank liquidity, and focused on the internal factors that determine the liquidity of 10 Ethiopian banks in the period 2007 to 2013. The author used panel and or longitudinal data model (see Selig & Little, 2012), which involved the pooling of observations over several periods. The fixed-effect panel data model (see Bell & Jones, 2015) was selected and used for hypothesis testing. The Eviews 6 software econometric package was used to perform the regression. The results of the regression analysis show that total assets as a proxy for bank size had a positive influence on the liquidity of commercial banks. Capital adequacy represented by proxy as the ratio of equity to total assets and profitability represented by proxy as return on assets had a negative influence on liquidity of commercial banks (Melsese and Laximikantham, 2015). Bank capital tends to impede on liquidity creation through two distinct effects: the fragility structure and the crowding-out of deposits (Melsese and Laximikantham (2015). Loan growth and non-performing loans had no influence on commercial bank liquidity. The findings of this study were contrary to the findings of the study by Tesfaye (2012), which also focused on the determinants of bank liquidity in Ethiopia.

Mugomba et al. (2013) considered the effect of liquidity risk on bank solvency in Zimbabwe, and focused on 12 Zimbabwean banks over the period 2009–2012. These authors used the ANOVA regression analysis (see Glantz, Slinker & Neilands, 2016) to analyse the data and look at bank-specific factors (i.e. bank solvency, inflation, non-performing loans, profitability and bank size) as well as macroeconomic factors (i.e. inflation and GDP) that could affect liquidity (Mugomba et al., 2013). The results of this research show that capital risk has a strong influence on bank solvency (Mugomba et al., 2013). Furthermore, the results show that banks in Zimbabwe do not jointly manage liquidity, together with credit risk, capital risk and profitability, but are

independent of each other (Mugomba et al., 2013). In a study by Chagwiza (2014) to identify the determinants of liquidity of Zimbabwe commercial banks, the author used data covering the period January 2010 to December 2011. Regression analysis was used and the results confirmed that there is a positive link between bank liquidity and capital adequacy, total assets, GDP and bank rate. Additionally, the adoption of multi-currency, inflation rate and business cycle has a negative effect on liquidity. Bank size and their liquidity are positively correlated (Chagwiza, 2014).

Aikaeli (2006) studied the determinants of excess liquidity in Tanzanian commercial banks. In this study, monthly banking sector data was collected over the period June 1999 to December 2004 and used the autoregressive distributed lag (ARDL) model (see Hill, Griffiths & Lim, 2008) to analyse the data in the long and short run. The results of this study revealed that in the long run, an increase in the rate of required reserves lowers the excess liquidity of commercial banks (Aikaeli, 2006). In addition to this, factors such as the volatility of cash preference, the bank-borrowing rate, and variations of loans return or credit risk, have a positive effect on excess liquidity. In the short run, two scenarios existed, i.e. considering treasury bills as liquid assets for commercial banks, and considering treasury bills as one of the earning bank investments with almost the same characteristics as illiquid assets (Aikaeli, 2006). Both results had the same outcomes and considered that the contemporary amount of excess liquidity is decreased when banks manage to accumulate substantial quantities of liquidity in the previous periods. If the Central Bank of Tanzania puts pressure on reserves, commercial banks hedge by accumulating more protective liquid assets (Aikaeli, 2006). An increase in the bank-borrowing rate makes the banks aware of the possible risk-cost associated with liquidity shortage in an event that the liquidity shortage happens.

Uremadu (2009) studied the determinants of financial system liquidity in Nigeria. The author used money market instruments comprising treasury bills (TBs), treasury certificates (TCs), eligible development stocks (EDSs), certificates of deposits (CDs), commercial papers (CPs) and bankers acceptances (BAs), spanning the period 1980 to 2005, using the target regression technique (see Kocev, Džeroski, White, Newell & Griffioen, 2009). The regression results indicated that CPs had the greatest significance on bank liquidity in Nigeria, followed by TCs, EDSs and TBs. However,

qualitatively, CPs, TCs, CDs and BAs had a negative effect on the banking system liquidity ratio while TBs and EDSs had a positive effect on the banking system liquidity.

A study by Siaw (2013) to investigate the determinants of bank deposits in Ghana, produced different results to studies conducted in the euro area, North America, South America, Central America and some parts of Africa. In this study, Siaw used time series data of financial and macroeconomic variables for the period 2000 to 2013. The author used two categories of time series variables (i.e. economic and financial variables in the deposit determinants of banks in Ghana) (Siaw, 2013). The economic data consisted of growth of money supply (GMS), consumer price index (CPI), the monetary rate (MR), and the all-share index (ASI). On the other hand, financial variables consisted of the interest rates on deposits (Siaw, 2013). The author used a co-integration mathematical model to analyse the study. The dependent variable was the total bank deposits (which include current, savings and fixed-deposit account balances) and independent variables (which included deposit interest rates, monetary policy rate, GMS, CPI and ASI). The results confirmed that in the long run, a negative change in deposit rate and CPI would have a negative effect on bank deposit (negative relationship). In the short run, a change in the independent variables will have an influence on bank deposits (Siaw, 2013). Inflation and GMS variables were found to be significant in explaining short-term dynamics of bank deposits. A change in the GMS had a negative effect on liquidity and a change in CPI also produced a negative effect on bank deposits (Siaw, 2013).

Moussa (2015) conducted a study on the determinants of bank liquidity in Tunisia. The author used a sample of 18 banks in Tunisia over the period 2000 to 2010. Two measures of liquidity were estimated, namely liquid assets/total assets and total loans/total deposits), using the static panel and method of panel dynamic methods (see Matyas & Sevestre, 1996). The results confirmed that financial performance, capital/total assets, operating costs to total assets, growth rate of GDP, inflation rate and delayed liquidity have a significant effect on bank liquidity. Size, total loans/total assets, financial costs/total credits, total deposits/total assets did not have a significant effect on bank liquidity (Moussa, 2015).

Sheefeni and Nyambe (2016) studied the determinants of liquidity in Namibia over the period 2001 to 2014, using the autoregressive distributive lag (ARDL) model (see Hill,

Griffiths & Lim, 2008). The results revealed that real GDP is the main determinant of liquidity of commercial banks in Namibia. It was also found that monetary policy rate is positively related to liquidity of banks although statistically insignificant. However, the results also showed a negative relationship between inflation and the liquidity of commercial banks (Sheefeni & Nyambe, 2016).

3.8 CHAPTER CONCLUSION

In summary, this chapter focused on empirical studies reported in literature. The common theme from some of the empirical studies listed above reflected the different results reached on the determinants of bank liquidity. Although the different authors have reached diverse results, the more dominant and common results were ones that focused on bank internal factors as internal determinants (i.e. the capitalisation of the bank, size of the bank, loan growth and non-performing loans) as well as macroeconomic factors (i.e. inflation rate and GDP growth) and their relationship with liquidity. In most of these studies, the authors used a regression model to analyse data to determine the relationship. It is on this basis that the present study has been conducted and the hypothesis, based on the abovementioned studies, was formulated and tested.

CHAPTER 4: METHODOLOGY

4.1 INTRODUCTION

This chapter will present the research questions, hypotheses, research approach and methodology. The chapter is arranged as follows: section 4.2 presents the research design adopted for this study. Section 4.3 presents the research objectives, questions and the hypotheses for this study. Section 4.4 explains the sampling design for this study. This is followed by an explanation of the data collection, presentation and analysis techniques in section 4.5. Section 4.6 presents the regression model used for this study. Finally in section 4.7, the data processing techniques used in this study are discussed.

4.2 RESEARCH DESIGN

In this research, data used included amongst other things, commercial banks liquidity ratios. These ratios were derived from secondary data sources from the SARB

The quantitative research method was carried out to investigate the relationship between bank liquidity and the independent variables (micro-economic/bank-specific and macroeconomic).

4.2.1 Quantitative research

According to Tustin, Ligthelm, Martins and Van Wyk (2010: 89), quantitative research is research that is based on the collection of primary data from a large number of individuals with the intention of projecting the results to a wider population. According to Senchantichai and Sukamolson (2013: 1), quantitative research is an illustration of numerical data and an interpretation of observations for the purpose of unfolding and clarifying the singularities that are reflected by the observations. Furthermore, Cohen, Manion & Morrsion (2002) elaborate that this type of research applies empirical methods and empirical statements. These empirical statements, which are expressed in numerical terms are an explanation that takes into account the empirical assessment and describe what the case is in the real world rather than what the case should be.

Cresswell (2013:18) describes quantitative research as research that explains singularities by collecting numerical data, which is analysed using mathematically based methods (i.e. statistics). This description can be broken down into three elements. The first element refers to the explanation of singularities. Singularities are an important element of research and seek to explain something. The second element refers to numerical data, and is directly linked to the third element, which is mathematically based. In order for mathematically based methods to be used, numerical data must be available (Cresswell, 2013). In essence, because quantitative research is about collecting data to explain certain singularities, there are very pertinent questions that are frequently used, namely What, How and Where.

4.2.2 Differences between quantitative research and qualitative research

According to Senchantichai and Sukamolson (2013), there is also another type of research, namely qualitative research. While quantitative research is based on numerical data, which is analysed statistically, qualitative research uses non-numerical data. Qualitative research encompasses methods, such as interviews, case studies, ethnographic research and discourse analysis (Senchantichai & Sukamolson, 2013). These two types of research could lead people to talk about 'paradigm wars' (see Bergman, 2008: 89), as quantitative and qualitative researches are often antagonistic and incompatible factions. Quantitative research views can be described as either realistic or positivistic, while the qualitative researcher is either a follower of the subjectivism or the positivism (Guba and Lincoln, 1994). Realists take a view that the objective of a research is to uncover an existing reality. The trust exists somewhere and the researcher can use research methods to uncover it (Sechantichai & Sukamolson, 2013). This implies that the researcher must be emotionally as far as possible removed from the research and use methods that can optimise objectivity to uncover the truth (Senchatichai & Sukamolson, 2013).

4.2.3 Post-positivism, experiential realism and pragmatism

According to Ryan (2006: 13), a post-positivist assertion refers to a situation where scientific methods and language are used to investigate and write about human experiences, keeping the research free of the values, passions, politics and ideology of the researcher. This stance requires the researcher to have an ability to see beyond

the now, to look at the research from a distance, have objectivity, a fair degree of passion and the ability to scrutinise (Ryan, 2006).

Senchantichai and Sukamolson (2013) highlight the second view, namely experiential realism. Experiential realists together with anti-positivists assert that we cannot observe the world in a purely objective way, because our perception itself influences what we see and measure in contrast to subjectivists (Senchantichai & Sukamolson, 2013). Experiential realists argue that there is a limit to subjectivity. Humans are limited in their subjectivity by the fact that we use a limited number of diagrams to formulate our view of the world because our perception is personified. We observe actively and not passively (Senchantichai & Sukamolson, 2013).

4.2.4 Attributes of quantitative research

Quantitative research has the following attributes: it causes and effects thinking, there is a reduction of variables, hypotheses and questions, it uses measurement and observation and the test of the theories (Ryan, 2006). The test of theories uses experiments and surveys, and collection of data on predetermined instruments (Ryan, 2006: 13).

4.2.5 Advantages of quantitative research

The following are the advantages of quantitative research:

1. provides estimates of populations at large;
2. indicates the extensiveness of attitudes held by people;
3. provides results which can be condensed to statistics;
4. allows for statistical comparison between various groups;
5. has precision, is definitive and standardised; and
6. measures level of occurrence, actions, trends and can answer questions such as how many and how often?

The purpose of this study was to establish the determinants of commercial banks' liquidity in South Africa and based on the abovementioned facts, a quantitative research methodology comprising statistical types of data analysis was used to come to a conclusion, to determine the relationship between these determinants and

liquidity. This was done by replicating previous empirical studies conducted by other authors in other countries. The next section outlines the research objectives, variable description and hypotheses.

4.3 RESEARCH OBJECTIVES, VARIABLE DESCRIPTION AND HYPOTHESES

This section will focus on the research objectives, research questions, variables description and hypotheses.

4.3.1 Research objectives

The main objective was to determine the relationship between the dependent variable (liquidity) and the independent variables (bank specific factors and macroeconomic factors) by testing the hypotheses that are linked to the relationships between liquidity, the bank-specific and macroeconomic factors related to it and their effect on liquidity in South Africa. This will be achieved by using the following objectives:

1. to examine the relationship between capital adequacy and bank liquidity;
2. to determine the relationship between bank liquidity and bank size;
3. to determine the relationship between bank liquidity and loan growth;
4. to investigate the relationship between bank liquidity and non-performing loans; and
5. To examine the connection between macroeconomic factors and bank liquidity.

The dependent and independent variables, six specific hypothesis that were developed are discussed in the next subsections.

4.3.2 Research questions

Tesfaye (2012: 43) mentions that, according to the financial intermediation theory (see Diamond, 1984), every bank creates liquidity, and the amount of liquidity created by every bank varies based on its liquidity position. Furthermore, there are broadly two major determinants of commercial banks holdings of liquid assets, namely banks' internal, macroeconomic factors or external factors. This study focused on a combination of bank-specific and macroeconomic factors that affect the liquidity positions of banks. The bank-specific factors investigated were:

1. capital adequacy – a measure of the bank's capacity to absorb risk;
2. size of bank – a measure of the bank's ranking within its banking sector;
3. loan growth – a measure of growth in illiquid assets; and
4. Npls – a measure of the quality of the loans in a bank's book.

These factors combined represent the bank's internal or bank-specific factors. Two other factors investigated were:

5. inflation – the rate at which the general level of prices for goods and services is rising; and
6. GDP, that is the monetary value of all the finished goods and services produced within a country's borders in a specific time period (see Delechat et al., 2012).

These factors represent the macroeconomic or external factors (Tesfaye, 2012). Based on these, the following two questions were formulated.

Q1: What are the determinants of commercial banks' liquidity in South Africa?

According to Bouwman (2013: 1), the process of a bank creating liquidity is vital for the economy and even more noticeable during a financial crisis. However, the process of creating liquidity can also present a number of risks, more specifically liquidity risk. This risk can be prevented by holding liquid assets, such as cash. Additionally, cash reserves may not be sufficient if the depositors withdraw their deposits, fearing that the bank might close down due to a run by other depositors (Bouwman, 2013). In an empirical study by Berger and Bouwman (2009), the authors found that creating liquidity for clients could result in a bank being illiquid. This is backed by results from an empirical study by Ivashina and Scharfstein (2010), where it was confirmed that after Lehman Brothers had collapsed during the subprime lending crisis in 2007 (see Swedberg, 2010), there was a run by borrowers, who withdrew the loan commitments. The above thus confirm the liquidity creation process, which might affect the liquidity of banks.

Q2: Which effect do these determinants have on liquidity?

In this research, the main objective was to determine the relationship between the dependent variable (liquidity) and the independent variable (bank specific factors and

macroeconomic factors) by testing the hypotheses that are linked to the relationships between liquidity, the bank-specific and macroeconomic factors related to it and their effect on liquidity in South Africa. The hypotheses below were developed, based on findings of previous studies performed. The following subsections (4.3.3 and 4.3.4) discuss some of the ratios that were used as proxies of measuring liquidity.

4.3.3 Dependent variable

The dependent variable, liquidity, was studied. According to Vodova (2012) and Vodova (2013), liquidity ratios are various balance sheet ratios, which should identify main liquidity trends. These ratios reflect that banks should be sure that appropriate, low-cost funding is available in a short time. For the purpose of this study, the following liquidity ratios were used (4.1) to (4.4).

$$\mathrm{L1} = \frac{\text{Liquid assets}}{\text{Total assets}} \quad (4.1)$$

Ratio L1 gives us information about the general liquidity shock absorption capacity of a bank (Vodova,2012). According to Marozva (2017), the liquid asset to total asset ratio is a ratio that has been used in previous studies to capture the asset liquidity of the bank (Bourke, 1989; Molyneux & Thornton, 1992; Vodova, 2011). This ratio gives information about the general liquidity shock absorption capacity of a bank (Berhanu, 2015). The higher the ratio, the higher the liquidity and the more stable is the financial institution in question.

$$\mathrm{L2} = \frac{\text{Liquid assets}}{\text{Deposits+short-term borrowings}} \quad (4.2)$$

This ratio is focused on the bank's sensitivity to selected types of funding, such as deposits by households, enterprises and other financial institutions. A variation of liquid assets to deposits plus short-term borrowing ratios were previously empirically employed in studies by Kosmidou, Tanna and Pasiouras (2005), Shen, Chen, Kao and Yeh (2009) and Vodova (2013). This ratio indicates the vulnerability of a bank to changes in different forms of funding, such as deposits from individuals or households, public and non-public enterprises, non-profit organisations (NPOs) and other financial

institutions (Marozva, 2017). Likewise, the higher the value of this liquidity ratio, the less sensitive the bank is to liquidity shocks and therefore, the less vulnerable such bank is to failure (Malik & Rafique, 2013).

$$L3 = \frac{\text{Loans}}{\text{Total assets}} \quad (4.3)$$

This ratio measures the share of loans in total assets and indicates which percentage of the assets of the bank is tied up in illiquid assets. The loans to total assets ratio (L3) shows the proportion of loans as part of total assets, and indicates the portion of assets of the bank that are tied up in illiquid loan assets (Marozva, 2017). The higher the ratio, the less attractive the bank is. A higher ratio indicates that the bank may fail to pay its dues as loans cannot be converted to cash easily (Berger, Bouwman, Kick, & Schaeck, 2016).

$$L4 = \frac{\text{Loans}}{\text{Deposits+short-term financing}} \quad (4.4)$$

This ratio relates to illiquid assets with liquid liabilities. According to Marozva (2017), this ratio relates to banks' illiquid assets with liquid liabilities. The higher the value of these ratios, the more illiquid the bank is and therefore the higher its vulnerability to liquidity shocks (Kosmidou, 2008).

Ratios (L1–L4) were used as proxies of measuring liquidity in studies conducted by Tesfaye (2012), Choon et al. (2013), Vodova (2013) and Berger and Bouwman (2009) in measuring the liquidity.

4.3.4 Independent variables

In this subsection, independent variables and hypotheses formulated are described.

4.3.4.1 Capital adequacy (CAP)

According to Tesfaye (2012), capital of banks consists of common stocks plus surplus funds plus undivided profit plus reserves for contingencies and other capital reserves. Studies by Vodova (2012), Subedi and Neupane (2013) and Laurine (2013) found a negative and significant relationship between capital adequacy and liquidity. These

studies highlighted that bank capital tends to obstruct liquidity creation through two effects: the financial fragility structure and the crowding out of deposits as stated by Melsese and Laximikantham (2015). The financial fragility liquidity structure comprises lower capital, which supports liquidity (Diamond & Rajan, 2001). This structure is symbolised by a bank that raises its funds from investors to finance an entrepreneur (Diamond & Rajan, 2001). The entrepreneur in turn, may suppress the effort, resulting in the reduction of bank financing. The existence of a deposit contract mitigates that banks holdup problem because depositors may run on the bank if the bank threatens to withhold effort and therefore capitalising on liquidity creation (Berger & Bouwman, 2012). Providers of liquidity to the bank cannot run on the bank, which restricts their willingness to provide funds and hence reduces liquidity creation. Therefore, the higher a bank's capital ratio, the less liquidity it will create (Berger & Bouwman, 2012). The second effect is higher capital ratios, which have the ability to reduce liquidity creation due to crowding out of deposits. In a study by Gorton and Winton (2000), it was found that deposits are more effective liquidity hedges for investors than investments in equity capital, which confirmed that higher capital ratios shift investors' funds from moderately liquid deposits to moderately illiquid bank capital, reducing the overall liquidity for investors Melsese and Laximikantham (2015). On the other hand, findings from empirical studies performed by Vodova (2013), Choon et al. (2013) and Tesfaye (2012) were contrary to the above in that they confirmed that there is a positive relationship between capital adequacy and liquidity. This was driven by the expectation that solvent banks are liquid too (Tesfaye, 2012). Therefore, the following hypothesis has been formulated and was tested.

H1: Capital adequacy has a positive and statistically significant effect on bank liquidity.

4.3.4.2 Size of bank (SIZE)

The size of the bank is represented by its total assets (Marozva, 2017). Results from studies conducted by Tesfaye (2012), Pasiouras and Kosmidou (2007) and Audo (2014) confirmed that there is a positive relationship between the size of a bank and liquidity. The theory behind this relationship is highlighted in a study by Audo (2014) and another by Roman and Sargu (2015), which highlight the too-big-to-fail argument (see Stern and Feldman, 2004). This argument states that large banks benefit from an

implicit guarantee, which reduces their cost of funding and gives them the ability to invest in riskier assets (Zhou, 2009). This status thus has the potential to lead to a death trap and substantial riskier exposure (Stern and Feldman, 2004). Large banks use their too-big-to-fail status as their motivation not to hold liquid assets, and in the case of a liquidity run, they would rely on liquidity assistance from the lender of last resort (see Goodhart & Illing, 2002). This results in large banks creating high levels of liquidity creation and having to sell illiquid assets to meet the needs of their clients (Berger & Bouwman, 2012). In a study by Dietrich, Hess & Wanzenried (2014) on the good and bad news about the new liquidity rules of Basel III (see BCBS, 2010), the authors argue that due to their too-big-to-fail status, large banks would have to respond to the moral hazard incentives by taking excessive risk. Excessive risk taking by large banks would mean that they engage in severe transformation ratio of loans to deposits (see Diamond & Dybvig, 1983), which will result in a decrease in bank liquidity. The following hypothesis was formulated and tested.

H2: Size of bank has a positive and statistically significant effect on bank liquidity.

4.3.4.3 Loan growth (LG)

Zemel (2012) expresses loan growth as the expansion or contraction of a bank's loan portfolio, and loans are the bank's main investment. Melsese and Laximikantham (2015) conducted a study on the determinants of commercial bank liquidity in Ethiopia. Results of this study concluded that there is a positive relationship between loan growth and liquidity, based on the finding that the effect on loan growth on liquidity is statistically insignificant. A substantial number of loans were provided from sporadic deposits and this did not affect the amount of liquidity available within Ethiopian banks. On the other hand, studies by Cornett et al. (2010) and Vodova (2012) confirmed that there is a negative relationship between loan growth and liquidity. Pilbeam (2005) summarises the theory behind this relationship, and notes that loan growth is dependent on the amount of liquidity banks holds. Banks compensate for the reduction in loan demand by holding more liquid assets (Pilbeam, 2005). When loan demand is high, banks hold less liquid assets, as this has a positive effect on their profitability. Therefore, for this study, it was assumed that growth in loans has a negative effect on banks' liquidity.

H3: Loan growth has a negative and statistically significant effect on bank liquidity.

4.3.4.4 Non-performing loans

According to Audo (2014: 22), non-performing loans (NPLs) NPLs are loans that are outstanding both in principal and interest for a long time contrary to the terms and conditions in the loan contract. A great amount of NPLs could cause depositors to lose confidence in the bank, therefore leading to a bank run, which has the potential to result in liquidity problems for the bank (Audo, 2014). In studies by Choon et al. (2013) and Vodova (2013), the researchers confirmed that there is a negative relationship between NPLs and liquidity. This conclusion was reinforced by the fact that when banks extend excessive lending, the possibility of a default increases, which in turn reduces commercial bank liquidity. The above conclusion has been confirmed by Tesfaye (2012) in a study of the determinants of commercial bank liquidity in Ethiopia. If the bank considers a loan as a bad debt, the bad debt can translate to losses or reduction in profitability. This leads to uncertainty within depositors, causing them to run against the bank (Tesfaye, 2012). This confirms that there is a negative relationship between NPLs and bank liquidity (Tesfaye, 2012). Therefore, for this study, the hypothesis was adopted was that NPLs have a negative and significant effect on bank liquidity.

H4: Non-performing loans have a negative and statistically significant effect on bank liquidity.

4.3.4.5 Gross domestic product (GDP)

GDP points to the overall economic soundness of a country (Tesfaye, 2012). Choon et al. (2013) studied the determinants of commercial bank liquidity in Malaysia. The researchers concluded that an increase in GDP would result in a corresponding increase in bank liquidity because during an economic boom, an increase in the number of loans is likely. This will result in a decrease in the banks' liquidity buffers confirming a positive relationship between GDP and bank liquidity. However, in contrast, according to the theory of bank fragility (see Diamond & Dybvig, 1983), during a recession, banks reduce their long-term investments (i.e. granting of loans) confirming a negative relationship between GDP and bank liquidity (Tesfaye, 2012).

The theory is also confirmed by Audo (2014). Therefore, the hypothesis that GDP growth has a negative and significant effect on bank liquidity was formulated for this study.

H5: GDP growth has a negative and statistically significant effect on bank liquidity.

4.3.4.6 Inflation

Inflation is explained as an increase in the general price of goods and services, over a period of time, in an economy (Tucker, 2007). Tesfaye (2012: 49) confirms that an increase in the rate of inflation drives down the real rate of return – not just on money, but on assets in general. The lessening of the real rate of return aggravates credit market uncertainties (Tesfaye, 2012). Such uncertainty leads to fewer loans being granted, inefficient allocation of resources, and the intermediary activities of bank contracts, having a negative effect on capital and/or long-term investments (Tesfaye, 2012). During such events, liquid or short-term assets held by banks increase in line with the increase in inflation. Furthermore, Audo (2014) indicates that an increase in the rate of inflation reduces the real rate of return both in monetary and asset terms. This reduction in returns aggravates credit market frictions (Audo, 2014). These frictions result in reduction in credit extension, which worsens during higher increases in inflation (Audo, 2014). Credit extension translates to few loans being granted, and the intermediary role of the bank lessens, which has stern implications on long-term capital investment (Audo, 2014). This then results in short-term liquidity holdings of banks increasing, in line with the increase in the rate of inflation (Audo, 2014). Given the above, the hypothesis that inflation has a positive and significant effect on bank liquidity was formulated for this study.

H6: Inflation has a positive and statistically significant effect on bank liquidity.

The variables and their proxies are summarised in Table 4.1

Table 4.1 summary of independent variables and proxies

Independent variables	Proxies and definitions	Proxies by	Expected sign of coefficient
Capital adequacy (CAP)	CAP: capital of banks consists of common stocks plus surplus funds plus undivided profit plus reserves for contingencies and other capital reserves	Tesfaye, (2012), Vodova (2013) and Choon et al. (2013)	Positive & Sig
Size of bank	Size: natural logarithm of total assets of the bank	Tesfaye, (2012), Pasiouras and Kosmidou (2007)	Positive & Sig
Loan growth	LG: Expansion or contraction of a bank's loan portfolio	Cornett et al. (2010), Zemel (2012) and Vodova (2012)	Negative & Sig
NPLs	NPL: non-performing loans are loans that are outstanding both in principal and interest for a long time contrary to the terms and conditions in the loan contract	Audo (2014) and Vodova (2013); Choon et al. (2013)	Negative & Sig
GDP	GDP: growth rate of real domestic product	Tesfaye, (2012), Choon et al. (2013) and Vodova (2012)	Negative & Sig
Inflation	CPI: the increase in the general price of goods and services, over a period of time, in an economy	Tucker (2007) and Tesfaye, (2012)	Positive & Sig

Source: Author's compilation

4.4 SAMPLING DESIGN

In order to be able to investigate a problem, the entire population should be considered. However, this is practically not possible and thus alternatively, a sample that is representative of the entire population, is selected (Acharya, Prakash, Saxena & Nigam, 2013). The population and sample for this study is thus selected and discussed in the ensuing subsections.

4.4.1 Population

According to Blanche, Blanche, Durrheim & Painter (2006: 133), the population of a study is the larger pool from which sampling elements are drawn and to which findings will be generalised. For this research, the population was the South African banking sector. Data from the SARB (see SARB, 2017) confirms that, as at 31 December 2016,

there were 18 registered and licenced commercial banks in South Africa. Table 4.2 below lists the names of these, in order of their size by total assets.

Table 4.2 South African banking sector: names of banks registered or licensed in terms of the Banks Act No. 94 of 1990.

Name of bank	Total assets as at 31 December 2017 (R Billions)	Ranking of bank by total assets
Standard Bank-South Africa Ltd	1 254	1
FirstRand Bank Ltd	1 120	2
Absa Bank Ltd	983	3
Nedbank Ltd	892	4
Investec Bank Ltd	415	5
Capitec Bank Ltd	87	6
African Bank Ltd	31	7
Grindrod Bank Ltd	16	8
Mercantile Bank Ltd	12	9
Bidvest Bank Ltd	9	10
Sasfin Bank Ltd	8	11
Albaraka Bank Ltd	6	12
UBank Ltd	5	13
HBZ Bank Ltd	4,8	14
The South African Bank of Athens Ltd	2,3	15
Habib Overseas Bank Ltd	1,2	16
Commonwealth Bank of South Africa Ltd	1,4	17
Discovery Bank Ltd	0,6	18

Source: South African Reserve Bank (2017))

4.4.2 Sampling frame

A sample is a subset of the total population, selected to represent the entire population (Bailey, 1987: 82). According to Tustin et al. (2010), a sample frame is a list of the population from which to select elements that will be sampled. Different sampling methods are identified and discussed below:

4.4.2.1 Non-probability sampling

Non-probability samples are those in which the probability that a subject might be selected is unknown. This results in selection bias in the study, which includes purposive sampling (Acharya et al., 2013). Purposive sampling is most effective when one needs to study a certain cultural domain with knowledgeable experts within (Acharya et al., 2013). The inherent bias of the method contributes to its efficiency, and the method stays robust even when tested against random probability sampling, (Tongco, 2007).

4.4.2.2 Purposive sampling

Purposive sampling is the commonly used form of sampling. It is not expensive and it has the ability to gather large amounts of information by using a range of different techniques (Tongco, 2007).

For the purpose of this study, purposive sampling was used by selectively taking commercial banks that operate in the same model (i.e. commercial banks that provide retail, business banking, corporate and investment banking divisions) and which had been in operation for the 10 years (from 2006 to 2016) preceding the present study. This period was selected due to the constant availability of data over that period.

4.4.2.3 Sample size

According to Choon et al. (2013: 50), sample size refers to the number of units in the population where the study will be based. The present study focused on twelve commercial banks over the period 2006–2016, which give a sample size of 120. The twelve banks selected were: Standard Bank of South Africa Ltd, FirstRand Bank Ltd, Absa Bank Ltd, Nedbank Ltd, Investec Bank Ltd, Capitec Bank Ltd, Grindrod Bank Ltd, Mercantile Bank Ltd, Bidvest Bank Ltd, Sasfin Bank Ltd, HBZ Bank Ltd and Albaraka Bank Ltd. These banks were chosen because, at the time of this research, together they accounted for almost 99% of the sector total assets (SARB, 2017). Moreover, the banks were included in the study due to the availability of their bank-specific data on the variables under investigation for the period 2006 to 2016.

4.5 DATA COLLECTION, PRESENTATION AND ANALYSIS

This section focused on the data collection, presentation and analysis.

4.5.1 Data collection

Only secondary data (see Hox & Boeije, 2005) was used for this research. The sources for data collection were the audited financial statements (balance sheet and income statements of the banks that formed part of the sample), data from the SARB and other sources, which were relevant to the study. The secondary data from the audited financial statements refers to the period ending on 31 December each year;

4.5.2 Data presentation and analysis

Variables (both independent and dependent) are calculated over the sample period and why correlation analyses between dependent and independent variables are prepared. Data collected from the different sources were analysed using the Eviews 9 software package, which revealed the relationship between independent and dependent variables.

4.5.4 Model specification

In order to make a proper observation of the relationship between the independent and dependent variables, the data used in this sample of South African banks was obtained from published financial statements and BA900 returns (see SARB, 2016) filed by banks to the central bank, which are readily available. Since all the banks are in South Africa, policy difference between countries was not a problem. A generalised methods of moments (GMM) panel regression model was used, which had to account for whether there were bank-specific variations or time-specific variations. In a study by Tesfaye (2012: 56–57), the author used the GMM panel data model for the following reasons:

1. The model can address a broader range of issues and tackle more complex problems with panel data than would be possible with pure time-series or pure cross sectional data alone.
2. The model is an easy tool to use to observe how variables or the relationships between dependent and independent variables change dynamically over time. To

do this using pure time-series data, would often require a long run of data simply to get a sufficient number of observations to be able to conduct any meaningful hypotheses tests.

3. By combining cross-sectional and time-series data, one could increase the number of degrees of freedom and the power of the test, by employing information on the dynamic behaviour of a large number of entities at the same time.
4. The additional variation introduced by combining the data in this way could also help to mitigate problems of multicollinearity that may arise if time series are modelled individually.
5. By restructuring the model in an appropriate way, it could remove the effect of certain forms of omitted variable bias in regression results.

In a study by Baltagi (2008) on the advantages and disadvantages of using panel data, the author highlighted the advantages of using panel data as follows:

1. Since panel data relates to banks (N), over a period of time (T), the likelihood of heterogeneity (see Chesher, 1984) existed in these banks. The benefits of using panel data are that panel data assumes that banks, which are being investigated are heterogeneous, while cross-sectional and times-series studies do not control for heterogeneity; therefore, they tend to report results that are biased (Hsiao, 2003).
2. Baltagi (2008) shows that, in a macro panel setup, if heterogeneity is ignored, i.e. the non-controlling of the individual institution-specific variables, this could result in the misspecification of the model.
3. Other advantages of panel data are that panel data improves the availability of more informative data implying more variability and less collinearity among the variables, more degrees of freedom and more efficiency (Hurlin & Venet, 2008).
4. Using the pooled panel model increases the number of observations significantly when compared to time-series data and cross-sectional data (Baltagi, 2008).

4.5.4.1 Choosing random-effects (RE) versus fixed-effects (FE) models

Baltagi (2008) highlights the disadvantages of panel data as the use of lengthy time series on countries, without considering the effect of cross-country dependency, which often results in poor fit, misspecification bias and false inferences being drawn.

(Baltagi, 2008). According to Brooks (2008), it is often said that the random-effects model (REM) is more appropriate when the entities in the sample can be thought of as having been randomly selected from the population, while a fixed-effects model (FEM) is more plausible when the entities in the sample effectively constitute the entire population or sample frame. In the present study, the decision whether to use an FEM or an REM would be based on the results of the Hausman's test. The Hausman test is used to test for model misspecification Balgati, 2008). In panel data analysis, the Hausman test can help to choose between FEM or REM (Baltagi, Bresson & Pirotte, 2003). The null hypothesis in this study is that the REM is preferred and the alternate hypothesis in this study is that the FEM is preferred. Essentially, the test looks to see if there is a correlation between the unique errors (see Hausman, 1978) and the regressors (see Hausman, 1978) in the model. The null hypothesis is that there is no correlation between the two, according to Hausman (1978). The Hausman test results are interpreted by the p-value. If the p-value is less than 0.05, the null hypothesis is rejected (Hausman, 1978).

4.6 REGRESSION MODEL: GENERALISED METHOD OF MOMENTS (GMM)

The generic dynamic GMM panel and longitudinal regression model is as follows:

$$yi\ t = \alpha y_{it-1} + \alpha + \beta xi\ t + ui\ t, \quad (4.6)$$

The subscript i signifies the cross-section and t characterises the time-series dimension. The left hand variable $yi\ t$ is the dependent variable, α is the intercept term, β is a k×1 vector of parameters to be estimated on the explanatory variables, $ui\ t$ is a 1 × k vector of observations on explanatory variables, t = 1, …, T ; = 1, …, N (see Arellano & Bover, 1995).

Earlier studies (see Marozva, 2017)) indicate that to remove bank-specific effects, the first difference of the GMM model above is presented as follows:

$$\Delta yi\ t = (1-\alpha) yi\ t + \alpha \Delta y_{it-1} + \alpha + \beta \Delta xi\ t + \Delta ui\ t \quad (4.7)$$

However, the differenced model is not efficient as it does not eliminate the correlation between the error component and the lagged variables because yi,−1 and εit remain correlated (Arellano & Bover, 1995). Consequently, this study also ran the model using

the GMM estimation technique with lagged values of the regressors as instruments. The present study employed the one-step GMM system estimation approach of Arellano and Bover (1995) and Blundell and Bond (1998) with level and lagged values of the variables as instruments. The one-step GMM system estimation approach (see Arellano & Bond, 1991) is an improvement from Arellano and Bond's (1991) GMM estimation technique. A dynamic estimation model (see Bond, Hoeffler & Temple, 2001) is assumed, as this is consistent with Opler, Pinkowitz, Stulz and Williamson (1999) who indicate that the current liquidity position depends on the liquidity position during the previous period. Thus, lagged liquidity independent variables are persistent over time.

The objective to examine the key determinants of the liquidity in selected South African commercial banks was achieved by regressing the liquidity (L1, L2, L3 & L4) against their determinants in 4.8.

$$\Delta L_{it} = (\alpha - 1)\Delta L_{it} + \beta_1 \Delta CR_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (4.8)$$

Where

L_{it}	is one of four liquidity ratios for bank i in time t
α	is the constant
β	is the coefficient which represents the slope of variables
δ_i	is the fixed effects in bank
ϵ_{it}	is the error term
CAP_{it}	is the capital adequacy of ith bank on year t
$SIZE_{it}$	is the size of ith bank on year t
LG_{it}	is the loan growth of ith bank on year t
NPL_{it}	is the non-performing loan of 1th bank on year t
GDP_t	is the real domestic or GDP growth of South Africa in year t
CPI_t	is the overall inflation rate in South Africa in year t

More specifically, the following equations were tested empirically to determine the main drivers of bank liquidity in South Africa:

$$\Delta L1_{it} = (\alpha - 1)\Delta L1_{it} + \beta_1 \Delta CR_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (4.9)$$

$$\Delta L2_{it} = (\alpha - 1)\Delta L2_{it} + \beta_1 \Delta CR_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (4.10)$$

$$\Delta L3_{it} = (\alpha - 1)\Delta L3_{it} + \beta_1 \Delta CR_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (4.11)$$

$$\Delta L4_{it} = (\alpha - 1)\Delta L4_{it} + \beta_1 \Delta CR_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (4.12)$$

4.7 DATA PROCESSING TECHINIQUES

Data processing is a stage that includes checking, editing, coding, recording and specifying special or unusual treatment of data before it is analysed (Heip, Herman & Soetaert, 1981). For vigorous results, the GMM model must not contain econometric problems, such as multicollinearity, heteroscedasticity, autocorrelation and the error for each variable must be constant (Choon et al*.,* 2013: 51). These terms are explained in subsections (4.7.1 to 4.7.4) below.

4.7.1 Multicollinearity

According to Cameron and Trivedi (2010), multicollinearity conditions exist where there is a high but not perfect correlation between two or more explanatory variables. Choon et al*.* (2013: 52) note that there are various ways to identify multicollinearity. The first way is by comparing the expected sign of independent variables obtained from the model with previous expectation. There is a possibility that a multicollinearity problem occurs when the expected sign of the independent variable is inconsistent with the theory or previous expectation. The second way is by examining the correlation matrix provided by Eviews 9. If it is found that the correlation between two variables is more than 80%, the assumption is that multicollinearity exists.

According to Gujarati (2004), should multicollinearity be detected, the variance inflating factors (VIFs) and tolerance (TOL) to detect seriousness of multicollinearity should be undertaken. VIF is undefined if $\boldsymbol{R^2}$ is equal to 1. The indication is that perfect multicollinearity between the two independent variables exists. If VIF is equal to or

more than 10, it indicates that there is serious multicollinearity, as opposed to no multicollinearity if $\boldsymbol{R^2}$ is equal to 0. There is always a negative relationship between seriousness of multicollinearity and the level of TOL, implying that the higher the TOL, the less serious is the multicollinearity as opposed to lower TOL, which implies more serious multicollinearity.

4.7.2 Heteroscedasticity

Heteroscedasticity occurs when the variance of error term is not constant across a number of observations (Choon et al*.,* 2013: 52). To ensure that heteroscedasticity does not exist, a hypothesis test was carried out during the present study, and the p-value did not contain heteroscedasticity problem. If the p-value obtained more than 10% significance level, it implied that heteroscedasticity did not exist in the model.

4.7.3 Autocorrelation

An autocorrelation problem will occur when the error term at period *t* is correlated with the error term at period before *t* (see Choon, et al., 2013). Autocorrelation is most likely to happen in the time-series data due to the importance of the sequence of the period. The autocorrelation test was carried out. The p-value obtained indicated the presence of an autocorrelation problem in the econometric model. If the obtained p-value is more than 10% significance level, it implies that there is no autocorrelation problem in the model (Choon et al*.,* 2013).

4.7.4 Normality of the error

According to Choon et al. (2013), the classical linear regression model (see Ramsey, 1969) assumes that the error is normally distributed, with the mean of error being zero as a positive error will offset the negative error. The ‘normality of the error’, can be tested in an informal way, which uses a graph to detect the pattern of the residual or the formal way, which is the Jarque-Bera test statistics (see Choon, et al., 2013). The Jarque-Bera test statistic requires the value of skewness and kurtosis in the model in order to calculate the Jarque-Bera test statistics value.

4.8 CHAPTER CONCLUSION

In this chapter, the researcher presented the sources of data collected. The financial ratio technique and macroeconomic data were adopted to estimate the determinants factors. The researcher used twelve South African commercial banks in this study. In this chapter, the researcher also discussed the method used to analyse the data and to determine the measurement testing to provide the empirical results of the study. The next chapter will discuss the data analysis, present the results of the regression model, discuss major findings and make recommendations for future research.

CHAPTER 5: DATA ANALYSIS, RESULTS AND SUMMARY

5.1 INTRODUCTION

In Chapter 4, the research questions, hypotheses, research approach and methodology were discussed. In order to attain the research objectives, obtain answers to the research questions and test the hypotheses, the data collected was presented and the imperative correlation and panel regression analysis findings were discussed. In Chapter five, the results will focus on data from four liquidity ratios obtained from twelve commercial banks. Data was obtained for the period of 10 years from 2006 to 2016. E-views 9 software was used to analyse the research findings and data. The bank internal factors that were researched were capital adequacy, size of bank, loan growth and NPLs. The macroeconomic factors that were researched were GDP and inflation. Given that the data was collected from a sample of commercial banks and not the complete population, it was therefore subject to sampling errors and tolerances (i.e. some differences may be statistically significant). This chapter will also present the conclusion and recommendations based on the findings.

The next section 5.2 will focus on the descriptive statistics of the dependent and independent variables, followed by the test for the absence of series multicollinearity assumption under section 5.3. Section 5.4 will present the results of the Hausman test, 5.5 will present the pooled, FE, RE and GMM regression results. Finally, the regression results are discussed under section 5.6.

5.2 DESCRIPTIVE STATISTICS OF THE VARIABLES

In this section, the descriptive statistics for the dependent and independent variables are presented. In the present study, the dependent variables were liquidity indicated as L1 (liquid assets to total assets ratio), L2 (liquid assets to deposits plus short-term borrowings ratio), L3 (loans to total assets ratio) and L4 (loans to customer deposits and short-term funding ratio). The independent variables were as follows: capital adequacy, size of the bank, loan growth, NPLs, GDP and CPI (which measures inflation).

The descriptive statistics for the liquidity ratios of the dependent variables in the pooled estimation model are summarised in Table 5.1 below.

TABLE 5.1: Descriptive statistics for dependent variables

Variable	Observations	Mean	Standard deviation (SD)	Minimum–Maximum
L1	120	0.91	0.12	0.28–0.99
L2	120	1.42	0.31	0.82–2.74
L3	120	0.75	0.12	0.24–0.92
L4	120	1.17	0.26	0.65–2.30

Source: Author's computation

From the summary of the descriptive statistics in Table 5.1, the total observations for each liquidity (dependent) variable were 120. The descriptive statistics were drawn from the calculated standard liquidity measures (namely L1, L2, L3 and L4).

From the data, the following could be confirmed:

L1 (liquid assets to total assets ratio) – L1 measures the level of liquid assets that banks hold in relation to total assets. L1 was close to 1, an indication that the greater portion of a bank's balance sheet was made up of liquid assets. The mean for L1 liquidity ratio was 0.91 and the standard deviation was 0.12. The minimum liquid assets to total ratio was 0.28, while the maximum was 0.99. This indicates that some of the banks could hold as little as 28% of their balance sheet in the form of liquid assets while on the extreme end, some banks could hold 99% of their balance sheet in the form of liquid assets.

L2 (liquid assets to deposits and short-term borrowings ratio) – L2 was above 1, which indicates that banks would have been able to pay for their obligations as they fell due. This confirms that South African banks are less susceptible to shocks in funding. The mean for the L2 liquidity ratio was 1.42 and the standard deviation (SD) was 0.31. The minimum for L2 liquidity measure was 0.82 while the maximum was 2.74.

L3 (loans to total assets ratio) – L3 was 0.75, which indicates that, at the time of this research, banks in general held 75% of their assets in the form of loans. This is justified by the core business of commercial banks, namely to issue loans (see Diamond & Rajan, 2001). The mean for L3 liquidity ratio was 0.75 and the SD was 0.12. The minimum for the L3 liquidity measure was 0.24 while the maximum was 0.92. This indicates that some banks were comfortable in having only 24% of their assets

constituting loans while other banks were aggressive and had 92% of their assets as loans. The loans to assets ratio indicates a proportion of loans relative to total assets. The greater the portion of assets in the form of loans the more the bank is susceptible to liquidity shocks while the lower the portion, the lower the risk of susceptibility to liquidity shocks (see Berger & Bouwman, 2009).

L4 (loans to customer deposits and short-term funding ratio) – This ratio measures the proportion banks' illiquid assets to liquid liabilities (see Marozva, 2017). L4 was above 1 at 1.17, which indicates that, at the time of this research, South African banks on average had the ability to fund illiquid assets (loans) using the liquid short-term liabilities (deposits and short-term funding). Should a bank or an institution be unable to maintain or source liquidity, by not having enough funds to settle its liabilities, it could end up being illiquid (Tesfaye, 2012).

The liquidity measures discussed above were regressed against the following set of independent variables:

1. the capital adequacy ratio (CAP) is measured by equity as a percentage of total assets;
2. size of the bank, a natural logarithm of total assets of the bank;
3. loan growth (LG), measured as either a contraction or expansion of the size of the bank's loan book;
4. NPL measured as the loans that have been outstanding both in principal and interest for a long time;
5. GDP growth, which is the economic growth measured by the growth rate of the real domestic product;
6. inflation represented by the consumer price index (CPI), which measures the increase in the general price of goods and services.

A summary of the descriptive statistics for the independent variables in the pooled estimation is presented in Table 5.2 below.

TABLE 5.2 Descriptive statistics for independent variables

Variable	Observations	Mean	SD	Minimum–Maximum
CPI	120	0.06	0.02	0.03– 0.12
CAP	120	0.15	0.12	0.04–0.64
GDP	120	0.03	0.02	-0.02–0.06
LG	120	1.19	0.23	0.65–2.01
NPL	120	-0.01	0.03	-0.16–0.01
SIZE	120	17.19	2.59	12.94–20.96

Source: Author's computation

In this section, the descriptive statistics of some of the variables are discussed. From the data, the following can be confirmed:

GDP and CPI – the GDP variable measures the growth of the economy while the CPI variable measures the general increase in the price of goods and services. From the data above, it is clearly indicated that between 2006 and 2016, the South African economy grew by an average of 3%, i.e. below the inflation average rate of 6%.

CAP – this variable measures the solvency of the banking sector. The CR was 15%, which indicates that, at the time of this research, the South African banking sector was adequately capitalised, with an average capital adequacy ratio of 15%, above the regulatory requirement of 9.75%. The minimum for CR was 0.04 and the maximum was 0.64, indicating that during the research period, some banks were poorly capitalised with a CR of 4% and some banks were adequately capitalised with a CR of 64%. Most of the banks' capital was approximately in line with the mean because the standard was 15%.

LG and **SIZE** – from Table 5.2, we can confirm that bank loan growth was at 119% for the period 2006 to 2016. This growth is in line with the growth in banks size at 1719%, which represents the growth in asset size of the banking sector.

5.3 TEST FOR ABSENCE OF SERIES MULTICOLLINEARITY ASSUMPTION

Multicollinearity condition exists where there is high but not perfect correlation between two or more explanatory variables (Cameron & Trivedi, 2010). When multicollinearity exists, the amount of information about the effect of the explanatory variable may be reduced, leading to overlooking the existence of a relationship between the explanatory variables and dependent variable, when there is a relationship (Churchill & Iacobucci, 2005). Correlation is allowed; however, it must not be perfect, otherwise multiple regressions would not be beneficial for econometric analysis in the absence of correlation between the independent variables (Churchill & Iacobucci, 2005). There is however no indication about how much correlation causes multicollinearity. Hair, Black, Babin, Anderson and Tatham (2006) argue that a correlation coefficient below 0.9 may not cause serious multicollinearity problems. On the other hand, Franke (2010) states that a multicollinearity problem exists when the correlation coefficient among variables is between 0.8 and 0.9. These statements demonstrate that there is no consistent argument on the acceptable level of correlation that would cause multicollinearity. The standard statistical method of testing data for multicollinearity is by analysing the explanatory variables' correlation coefficients, condition index and variance inflation factor (Gujarati, 2004). In this study, a correlation matrix for six independent variables shown in Table 5.3 below was estimated. According to the results on the correlation matrix, there is no correlation among the variables as their values were less than 0.9, except in the case of L4 and L2, which are both measures of liquidity and the dependent variable; hence, they were retained in the model.

Table 5.3: Correlation matrix between dependent and independent variables

	L1	L2	L3	L4	CPI	CR	GDP	LG	NPL	SIZE
L1	1.000	0.049	0.838	0.050	0.076	**-0.672	***0.022	*-0.268	*0.089	***0.276
L2	0.049	1.000	-0.050	0.915	0.046	0.413	-0.037	0.314	*-0.718	-0.027
L3	0.838	-0.050	1.000	0.170	0.092	-0.465	**0.110	-0.281	**0.086	***0.002
L4	0.050	0.915	0.170	1.000	0.074	*0.473	**0.023	0.237	-0.689	*-0.172
CPI	0.076	0.046	0.092	0.074	1.000	-0.010	-0.179	-0.207	-0.036	-0.014
CAP	**-0.672	0.413	-0.465	*0.473	-0.010	1.000	0.108	0.439	-0.270	-0.588
GDP	***0.022	-0.037	**0.110	**0.023	-0.179	0.108	1.000	0.268	0.045	-0.120
LG	*-0.268	0.314	-0.281	0.237	-0.207	0.439	0.268	1.000	-0.375	-0.341
NPL	*0.089	*-0.718	**0.086	-0.689	-0.036	-0.270	0.045	-0.375	1.000	0.039
SIZE	***0.276	-0.027	***0.002	*-0.172	-0.014	-0.588	-0.120	-0.341	0.039	1.000

Significant level *p < 1% **p < 5% ***p < 10% Source: Author's computation using Eviews 9.

5.4 HAUSMAN TEST

For the purposes of the present study, the GMM model was chosen as the appropriate model as the system GMM estimations do not have problems of endogeneity, unobserved heterogeneity liquidity persistence and autocorrelation (see Hausman, 1978). Fixed and random effect models were also run for the sake of completeness. Had the GMM model not been chosen, either the fixed effect or RE model would have been chosen, depending on the results of the Hausman test that would have been performed to determine which model. Brooks (2008) indicates that the REM is more appropriate when the entities in the sample can be thought of as randomly selected from the population, but an FEM is more credible when the entities in the sample effectively constitute the entire population. In other words, the null hypothesis (random effects) was preferred. According to Hausman and Stock (2003), the null hypothesis indicates that the coefficients estimated by the REM are similar to the ones estimated by the FEM, otherwise the fixed effects should be used. The Hausman test conducted in all four models indicated that the REM is preferred over the FEM, given that the chi-square statistic was 0.0000 and the p-value was 1.0000. The results of the Hausman test for L1, L2, L3 and L4 are indicated in Tables 5.4, 5.5, 5.6 and 5.7.

Table 5.4 Correlated random effects – Hausman test results for L1

Test summary	chi-square statistic	chi-square	P-value
Cross Section random L1	0.0000	7	0.7000

Cross-section random effects test comparisons:				
Variable	**Fixed**	**Random**	**Var (Diff.)**	**Prob.**
L1(-1)	0.757372	0.899992	0.000794	0.0000
CPI	-0.107216	0.111869	0.008944	0.0205
CAP	0.099552	-0.143645	0.015197	0.0485
GDP	0.012013	0.381168	0.008425	0.0001
LG	-0.102533	-0.066369	0.000136	0.0019
NPL	-0.578661	-0.533121	0.36946	0.9403
SIZE	-0.027519	-0.003636	0.000127	0.0343

Source: Financial statements of sampled commercial banks and own compilation through Eviews 9.

Results from the Hausman test for L1 confirm that the chi-square statistic was 0.0000, with a p-value of 0.7000, which was statistically insignificant. We therefore fail to reject the null hypothesis that the random effects were preferred over the FEM.

Table 5.5 Correlated random effects – Hausman test results for L2

Test summary	chi-square statistic	chi-square	P-value
Cross-section random L2	0.0000	7	0.7000

Cross-section random effects test comparisons:				
Variable	**Fixed**	**Random**	**Var (diff.)**	**Prob.**
L2(-1)	0.650093	0.706659	0.000938	0.0648
CPI	0.041185	0.222299	0.092878	0.5523
GDP	-0.460816	0.606349	0.089995	0.0004
CAP	1.769377	0.209804	0.154608	0.0001
NPL	2.297705	-1.820039	3.832544	0.0354
LG	-0.16141	-0.075881	0.001359	0.0203
SIZE	0.003353	0.008275	0.001193	0.8867

Source: Financial statements of sampled commercial banks and own compilation through Eviews 9.

Results from the Hausman test for L2 confirm that the chi-square statistic was 0.0000, with a p-value of 0.7000, which was statistically insignificant. We therefore fail to reject the null hypothesis that the random effects were preferred over the FEM.

Table 5.6 Correlated random effects – Hausman test results for L3

Test summary	chi-square statistic	chi-square	P-value
Cross-section random L3	0.0000	7	0.7000

Cross-section random effects test comparisons:				
Variable	**Fixed**	**Random**	**Var (diff.)**	**Prob.**
L3(-1)	0.650093	0.706659	0.000938	0.0648
CPI	0.041185	0.222299	0.092878	0.5523
GDP	-0.460816	0.606349	0.089995	0.0004
CAP	1.769377	0.209804	0.154608	0.0001
NPL	2.297705	-1.820039	3.832544	0.0354
LG	-0.16141	-0.075881	0.001359	0.0203
SIZE	0.003353	0.008275	0.001193	0.8867

Source: financial statements of sampled commercial banks and own compilation through Eviews 9.

Results from the Hausman test for L3 confirm that the chi-square statistic was 0.0000, with a p-value of 0.7000, which was statistically insignificant. We therefore fail to reject the null hypothesis that the random effects were preferred over the FEM.

Table 5.7 Correlated random effects – Hausman test results for L4

Test Summary	chi- square statistic	chi-square	P-value
Cross Section random L4	0.0000	7	0.7000

Cross-section random effects test comparisons:				
Variable	**Fixed**	**Random**	**Var(Diff.)**	**Prob.**
L4(-1)	0.584866	0.603021	0.000756	0.5091
CPI	-0.844281	-0.462914	0.080115	0.1779
GDP	0.307918	1.431818	0.076983	0.0001
CAP	1.6603	0.33257	0.139973	0.0004
NPL	1.519787	-2.424293	3.537983	0.036
LG	-0.30196	-0.188477	0.001224	0.0012
SIZE	-0.029095	0.00019	0.00108	0.3729

Source: financial statements of sampled commercial banks and own compilation through Eviews 9.

Results from the Hausman test for L4 confirm that the chi-square statistic was 0.0000, with a p-value of 0.7000, which was statistically insignificant. We therefore fail to reject the null hypothesis that the random effects were preferred over the FEM.

5.5 PRESENTATION OF THE REGRESSION RESULTS

This section presents the regression results.

5.5.1 Determinants of commercial banks liquidity results

A dynamic model estimation using four different methodologies was run. The GMM method was preferred over the other methods due to the endogeneity problem that exists amongst banks as highlighted by Baum, Schaffer and Stillman (2003) as well as the correlation that exists amongst the dependent variable and the lagged dependent variable when using a dynamic model (Kiviet, Pleus, & Poldermans, 2017). The system GMM estimations correct the problem of endogeneity, which is associated with other simple OLS models, and also the unobserved heterogeneity liquidity persistence and autocorrelation, according to Roodman (2006). The system GMM is also used where the distribution of the dependent variables is unknown. The entire results from the other methods will be presented for the sake of providing a robust check of the main model. Detailed results are presented in Appendix A.

The dynamic panel regression model used to find statistically significant determinants of commercial banks between of the dependent variables measures by L1, L2, L3 and L4 is expressed below:

$$\Delta L1_{it} = (\alpha - 1)\Delta L1_{it} + \beta_1 \Delta CAP_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (5.1)$$

$$\Delta L2_{it} = (\alpha - 1)\Delta L2_{it} + \beta_1 \Delta CAP_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (5.2)$$

$$\Delta L3_{it} = (\alpha - 1)\Delta L3_{it} + \beta_1 \Delta CAP_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (5.3)$$

$$\Delta L4_{it} = (\alpha - 1)\Delta L4_{it} + \beta_1 \Delta CAP_{it} + \beta_2 \Delta SIZE_{it} + \beta_3 \Delta LG_{it} + \beta_4 \Delta NPL_{it} + \beta_{5\Delta} GDP_t + \beta_6 \Delta CPI_t + \delta_i + \Delta\epsilon_{it} \quad (5.4)$$

A summary of the regression results for the pooled OLS, RE, FE and GMM results on liquidity measures and the lagged dependent variable is presented in Tables 5.8, 5.9, 5.10 and 5.11. The full regression results are attached as Appendices A, B, C and D. Although the results are presented for all the regression models, analysis is only based

on the GMM model results, as the system GMM estimations do not have problems of endogeneity, unobserved heterogeneity liquidity persistence and autocorrelation.

From the results of the regression for L1, L2, L3 and L4 below, it can be confirmed that there is a positive and statistically significant relationship between all the liquidity measures at time t and their lagged values at time t-1 at 1% level. The lagged liquidity is positive under the GMM model, which removed the endogeneity problem. This is a confirmation that the current liquidity levels of the banks are dependent on the liquidity buffers of the previous period.

Table 5.8: Summary of the results on the liquidity measure L1 regression

L1	Pooled OLS	RE	FE	GMM
L1(-1)	*1.007496 (26.87)	0.899992 (18.91)	0.757372 (13.69)	*0.899992 (18.91265)
CPI	0.247616 (1.13)	0.111869 (0.56)	-0.10722 (-0.49)	0.111869 (0.56)
GDP	0.342243 (1.46)	***0.381168 (1.83)	0.012013 (0.05)	0.381168 (1.83)
CAP	-0.018162 (-0.37)	**-0.14365 (-2.44)	0.099552 (0.73)	**-0.14365 (-2.44)
LG	***-0.042855 (-1.97)	*-0.06637 (-3.22)	*-0.10253 (-4.33)	*-0.06637 (-3.22)
NPL	*-0.422645 (-2.97)	*-0.53312 (-4.09)	-0.57866 (-0.93)	*-0.53312 (-4.09)
SIZE	***-0.000754 (0.48)	***-0.00364 (-1.85)	**-0.02752 (-2.40)	***-0.00364 (-1.85)
N	120	120	120	120
R-squared	0.86	0.86	0.90	0.86
F-statistic	–	*106.35	*51.59	–
J-statistic	–	–	–	*3.53E-21

Notes: t-statistics are in parentheses; significant level *p < 1% **p < 5% ***p < 10%; OLS
The summarised results were taken from Appendix A.

Source: Financial statements of sampled commercial banks and own compilation through Eviews 9.

Table 5.8 above presented the results of the liquid assets to total assets ratio (L1) as dependent variable and bank-specific and macroeconomic explanatory variables for the sample of twelve banks in South Africa. The explanatory power of this model is

indicated by the R-squared value, which was very high at 0.86, which means that about 86% of the variation in the liquidity is explained by bank-specific and macroeconomic variables. The F-statistic for both the RE and FE models is significant, meaning that the independent variables jointly influence the dependent variable. The regression J-statistic had a value of 3.53E-21, which was very significant confirming that the system GMM is fitted for this regression. We therefore fail to reject the null hypothesis that the model is not a fit.

The results confirm that capital adequacy, loan growth, NPLs and SIZE were the statistically significant factors that affected liquidity of commercial banks in South Africa. Capital adequacy had a negative and statistically significant effect on liquidity at 5% level. Loan growth and NPLs had a negative and statistically significant effect on liquidity at the 1% level. SIZE had a negative and statistically negative effect on liquidity at 10% level, while GDP growth and inflation were statistically insignificant. The coefficient signs of capital adequacy and GDP were in contrast to our expectation and in line with the findings of a study conducted by Subedi et al. (2013) on the determinants of bank liquidity and their effect on the financial performance in Nepalese commercial banks. In the present study, the researcher used data from six commercial banks and regressed them using a multivariate linear regression model over the periods 2002/2003 to 2011/2012. The results of this study concluded that capital adequacy and NPLs had a negative and statistically significant effect on commercial bank liquidity, while SIZE had a positive and statistically significant effect on commercial banks liquidity.

Table 5.9: Summary of the results on the liquidity measure L2 regression

L2	Pooled OLS	RE	FE	GMM
L2(-1)	0.735706 (11.27)	0.706659 (1.71)	0.650093 (9.47)	0.706659 (1.71)
CPI	0.636159 (1.01)	0.222299 (11.51)	0.041185 (0.06)	0.222299 (11.51)
GDP	0.633392 (0.88)	0.606349 (0.36)	-0.460816 (-0.64)	0.606349 (0.36)
CAP	***0.270392 (1.72)	0.209804 (0.93)	*1.769377 (4.22)	0.209804 (0.93)
NPL	-0.014017 (-2.60)	-1.820039 (-3.33)	**-0.161410 (1.13)	-0.075881 (-3.33)
LG	**-1.432674 (-0.23)	*-0.075881 (-1.17)	2.297705 (-2.16)	*-1.820039 (-1.17)
SIZE	*0.016063 (3.43)	0.008275 (1.33)	0.003353 (0.09)	0.008275 (1.33)
N	120	120	120	120
R-squared	0.79	0.79	0.84	0.79
F statistic	–	*60.31	*30.17	–
J statistic	–	–	–	*112.00

Notes: t-statistics are in parentheses; significant level *p < 1% **p < 5% ***p < 10%;
The summarised results were taken from Appendix B

Source: Financial statements of sampled commercial banks and own compilation through Eviews 9.

Table 5.9 above presented the results of the liquid assets to deposit and short term borrowings ratio (L2) as dependent variable and bank-specific and macroeconomic explanatory variables for the sample of twelve banks in South Africa. The explanatory power of this model is indicated by the R-squared value, which was high at 0.79, which means that about 79% of the variation in the liquidity can be explained by bank-specific and macroeconomic variables. The F-statistic for both the RE and FE models was significant, meaning that the independent variables jointly influence the dependent variable. The regression J-statistic had a value of 112.00, which was statistically significant at less than 1%. This means that we fail to reject the null hypothesis that the model is not a perfect fit.

Determinants of commercial banks liquidity measured by L2 were presented in Table 5.9 above. This ratio measures the bank's sensitivity to selected types of funding, which includes household deposits, enterprises and other financial institutions. The

results show that only one factor (loan growth) had a significant effect on the bank's sensitivity to selected types of funding. Loan growth had a negative and statistically significant effect on liquidity in South Africa at 1% level. Capital adequacy, Inflation, GDP growth and SIZE all had a positive and statistically insignificant effect on liquidity while NPLs had a negative and statistically insignificant effect on liquidity. The results of this regression are in line with the formulated hypothesis that loan growth has a negative and significant effect on bank liquidity. This is in line with the findings of studies conducted by Pilbeam (2005), which confirmed that in practice, the demand for loans which determine loans growth can severely affect the amount of liquidity that banks hold. Weak loan demand results in banks holding more liquid assets, whereas if the demand for loans is strong, banks tend to hold less liquid assets, as this is translates into profitability over a long-term period. The present study concluded that growth in loans and advances has a negative effect on banks' liquidity.

Table 5.10: Summary of the results on the liquidity measure L3 regression

L3	Pooled OLS	RE	FE	GMM
1)	0.587673 (19.52)	0.755308 (13.57)	0.587673 (9.05)	0.956955 (19.51)
CPI	**-0.719465 (-0.55)	-0.381112 (-1.47)	**-0.719465 (-2.52)	-0.174945 (-0.55)
GDP	0.336805 (0.46)	*0.824166 (3.07)	0.336805 (1.15)	**0.691193 (2.09)
CAP	-0.024979 (2.09)	*-0.189897 (2.77)	-0.024979 (-0.14)	0.030466 (0.46)
NPL	-1.033085 (-1.61)	*-0.678194 (4.04)	-1.033085 (-1.30)	**-0.446661 (-2.23)
LG	*-0.177249 (-2.23)	*-0.110805 (4.18)	*-0.177249 (-5.80)	-0.464497 (-1.61)
SIZE	*-0.056469 (1.95)	*-0.007992 (2.96)	*-0.056469 (-3.87)	***0.003622 (1.95)
N	120	120	120	120
R-squared	0.70	0.74	0.82	0.70
F-statitistic		*46.14	*26.76	–
J-statistic	–	–	–	*113.00

Notes: t-statistics are in parentheses; significant level *p < 1% **p < 5% ***p < 10%;
The summarised results were taken from Appendix C

Source: Financial statements of sampled commercial banks and own compilation through Eviews 9.

Table 5.10 above presented the results of the loans to total assets ratio (L3) as dependent variable and bank-specific and macroeconomic explanatory variables for the sample of twelve banks in South Africa. The explanatory power of this model is indicated by the R-squared value, which was high at 0.70, which means that about 70% of the variation in the liquidity is explained by bank-specific and macroeconomic variables. The F-statistic for both the RE and FE models was significant, meaning that the independent variables jointly influenced the dependent variable. The regression J-statistic had a value of 113.00, which was statistically significant at less than 1%. This means that we fail to reject the null hypothesis that the model is not a perfect fit.

Determinants of commercial banks liquidity measured by L3 were presented in Table 5.10 above. This ratio measures the share of loans in total assets and indicates the percentage of the assets of the banks tied up in illiquid assets. The results show that GDP growth, NPLs and SIZE were statistically significant factors that affected liquidity of commercial banks in South Africa. GDP growth and NPLs had a positive and statistically significant effect on liquidity at the 5% level. SIZE had a positive and statistically significant effect on liquidity at the 10% level. Inflation and loan growth had a negative and statistically insignificant effect on liquidity, while capital adequacy had a positive and statistically insignificant effect on liquidity.

Table 5.11: Summary of the results on the liquidity measure L4 regression

L4	Pooled OLS	RE	FE	GMM
L4(-1)	*0.699768 (10.03)	0.603021 (9.10	0.584866 (8.15)	0.699768 (10.03)
CPI	0.238317 (0.37)	-0.462914 (-0.78)	-0.844281 (-1.29)	0.238317 (0.37)
GDP	**1.469592 (2.07)	**1.431818 (2.32)	0.307918 (0.46)	**1.469592 (2.07)
CAP	*0.428074 (2.75)	**0.332570 (2.41)	*1.660300 (4.16)	*0.428074 (2.75)
NPL	*1.539735 (-3.02)	*-2.424293 (-4.79)	1.519787 (0.78)	*-1.539735 (-3.02)
LG	*-0.061627 (-1.06)	*-0.188477 (-3.07)	*-0.301960 (-4.27)	-0.061627 (-1.06)
SIZE	*-0.016279 (3.88)	0.000190 (0.03)	-0.029095 (0.87)	*0.016279 (3.88)
N	120	120	120	120
R squared	0.71	0.74	0.81	0.71
F-Statistic	–	*45.40	*23.55	–
J-Statistic	–	–	–	*113.00

Notes: t-statistics are in parentheses; significant level *p < 1% **p < 5% ***p < 10%;
The summarised results were taken from Appendix D.

Source: Financial statements of sampled commercial banks and own compilation through Eviews 9.

Table 5.11 above presented results of the loans to customer deposits and short term funding ratio (L4) as dependent variable and bank-specific and macroeconomic explanatory variables for the sample of twelve banks in South Africa. The explanatory power of this model is indicated by the R-squared value for the GMM, which was high at 0.71, which means that about 71% of the variation in the liquidity is explained by bank-specific and macroeconomic variables. The F-statistic for both the RE and FE models was significant, meaning that the independent variables jointly influenced the dependent variable. The regression J-statistic had a value of 113.00, which was statistically significant at less than 1%. This means that we fail to reject the null hypothesis that the model is not a perfect fit.

Determinants of commercial banks' liquidity measured by L4 were presented in Table 5.11 above. This ratio measures the share of illiquid assets with liquid assets. The results show that GDP growth, capital adequacy, NPLs and SIZE were statistically significant factors that affected liquidity of commercial banks in South Africa at the time of this research. GDP growth had a positive and statistically significant effect on liquidity at the 10% level. Capital adequacy, NPLs and SIZE had a positive and statistically significant effect on liquidity at the 5% level. Inflation had a positive and statistically insignificant effect on liquidity, while loan growth had a positive and statistically insignificant effect on liquidity. The results of this regression are in line with the hypothesis that capital adequacy and SIZE of the bank have a positive effect on bank liquidity.

5.6 DISCUSSION OF THE REGRESSION RESULTS

The regression results will be discussed in detail in this section.

5.6.1 Capital adequacy and liquidity

The GMM coefficient for capital adequacy under L1 was negative and statistically significant and for L1 and positive and statistically significant for L4, and the coefficients for capital adequacy under L2 and L4 were positive and statistically insignificant. Berger and Bouwman (2009) argue that, if a bank that funds itself and uses a model that excludes capital, makes a loss, it would be in a position to repay its obligations, thus making it insolvent. However, if a bank, which uses the capital mechanism, makes a loss, the loss is offset against the capital and the balance sheet will remain solvent, confirming that capital has a positive relationship with liquidity. The results of our regression for capital adequacy were therefore in line with the results from studies conducted by Berger and Bouwman (2009). This is consistent with findings from studies by Vodova (2011), who investigated the determinants of bank liquidity in the Czech Republic. The results from Vodova and Berger and Bouwman studies confirmed that capital adequacy has a positive effect on liquidity. Results from this study are also in line with studies conducted by Tesfaye (2012) on the determinants of bank liquidity in Ethiopia and their effect on the financial performance of banks. The findings from Tesfaye (2012) confirm that there was a positive relationship between liquidity and the capital adequacy of banks. This study confirms that capital is an integral part of bank liquidity and the higher the capital ratio, the more

South African banks will be able to create liquidity. The results of the present study were also in line with results from empirical studies conducted by (Vodova, 2013) on Hungarian banks and Choon et al. (2013) on the determinants influencing liquidity of Malaysian banks. Our conclusion in terms of the effect of capital adequacy on banks liquidity is based on the L1 and L4 model, namely capital adequacy has a positive and statistically significant effect on liquidity.

5.6.2 SIZE of the bank and liquidity

Bank size is measured by its total asset base (see Choon et al., 2013) and the bank's general capacity to undertake its intermediary function (Tesfaye, 2012). Theoretically, the liquidity of a bank is associated with its size: the bigger the bank, the bigger its appetite to undertake riskier activities for a longer term and are required to hold a significant level of liquid assets in order to meet a higher demand of loans and also unpredictable withdrawals which confirms a negative relationship between SIZE and liquidity (Marozva, 2017). This is supported by findings from studies conducted by Kashyap et al. (2002), which confirmed that smaller banks tend to be more liquid than bigger banks because these banks have trouble tapping into the capital markets, thus implying a negative relationship between the size of the bank and liquidity. The GMM coefficients for SIZE under L1 was negative and statistically significant and L3 and L4, were positive and statistically significant, while the coefficient under L2 was positive and statistically insignificant. These findings were consistent with the hypothesis created for this study that size has a positive and statistically significant effect on liquidity and in line with the results from a study conducted by Tesfaye (2012) where the determinants of bank liquidity within the Ethiopian banking sector were investigated. This study indicated that SIZE positively affected liquidity and supported the theory that as the size of the bank increases, the branch network increases. As the branch network increases, this will compel the bank in question to allow a significant portion of its balance sheet to be in the form of liquid assets, in order to meet the increased demand for loans as well as the corresponding levels of withdrawals (Marozva, 2017). This theory was also confirmed by the findings from studies by Audo (2014) who investigated the relationship between inflation rates and liquidity of commercial banks in Kenya, which indicated that large banks benefit from an implicit guarantee, which reduces their cost of funding and gives them the ability to

invest in riskier assets. South Africa's large banks use their "too big to fail' status as their motivation not to hold liquid assets, which in a case of a liquidity run could make them rely on the lender of last resort.

5.6.3 Loan growth and liquidity

Bank loan growth is the expansion or contraction of the loan portfolio (Zemel, 2012). Loans are the bank's main investment, and loans are instrumental in the determination of the bank's future cash flows (Zemel, 2012). The GMM coefficients for loan growth were negative and statistically insignificant for L1 and L2, and negative and statistically insignificant for L3 and L4. The results were in line with the hypothesis created for this study that loan growth has a negative and statistically insignificant effect on liquidity and with the results from a study by Pilbeam (2005), which confirmed that loans are illiquid assets, which confirms that positive loan growth translates into an increase in illiquidity over a long term. Loan growth is thus dependent on the amount of liquidity banks hold (Pilbeam, 2005). This shows that South African banks compensate for the reduction in loan demand by holding more liquid assets. During a season of high loan growth, South African banks would hold less liquid assets, thus confirming that an increase in loans would result in South African banks holding less liquid assets. The results are also in line with the theory from the studies conducted by Cornett et al. (2010), which highlighted the negative relationship between loan growth and bank liquidity. Banks with more illiquid asset portfolios (i.e. banks that hold more loans and securitised assets) increase their holdings of liquid assets and decreased lending, which relates to a positive relationship between loan growth and bank liquidity (Cornett et al., 2010). Banks that possess off-balance sheet liquidity risk in the form of undrawn loan commitments appeared as borrowers drew on previously approved loan facilities in large quantities (Cornett et al., 2010), displayed lending capacity and constrained new credit origination, thus showing that there is a negative relationship between loan growth and bank liquidity (Cornett et al., 2010).

5.6.4 Non-performing loans and liquidity

NPLs are classified as loans that are expected to translate to future losses for the banks (Zemel, 2012). NPLs result from underwriting poor credit quality assets, which turn out to be illiquid loans. In the present study, the GMM coefficients for NPLs were

negative and statistically insignificant for L1, L3 and L4 and negative and statistically insignificant for L2. The results for L1, L3 and L4 were in line with hypothesis created for this present study that NPLs have a negative and statistically significant effect on liquidity and the findings from studies conducted by Vodova (2013) and Marozva (2015), which confirmed that NPLs had a negative effect on liquidity. This is supported by the theory by Bloem and Gorter (2001) that if a bank has a high number of NPLs, it leads to a reduction in the bank's ability to extend credit further, resulting in a liquidity crunch and prejudicing other creditors who are in good standing. This eventually leads to investors and depositors withdrawing their funds, pushing the bank into a liquidity crisis. For South African banks, an increase in NPLs will result in a reduction in liquidity as the bank would have to raise provisions to cover for these loans, which would result in a negative relationship between an increase in NPLs and liquidity. We thus reject the hypothesis stating that NPLs have a negative and statistically significant effect on liquidity.

5.6.5 GDP growth and liquidity

GDP growth is a measure of total economic activity in an economy (Mugomba et al., 2013). The GMM coefficient for L1 and L2 was positive and statistically insignificant and for L3 and L4, it was positive and statistically significant. The results for L3 and L4 are in line with findings by Choon et al. (2013) that an increase in GDP resulted in a corresponding increase in bank liquidity, thus confirming a positive effect of GDP growth on liquidity. This was however in contrast with a study conducted by Aspachs et al. (2005), namely that there was a negative relationship between liquidity and GDP growth, supported by the theory that during an economic downturn, banks tend to place emphasis on liquidity by restricted lending (see Aspachs et al., 2005) and they neglect liquidity during an economic boom, when the climate is conducive to lending (see Aspachs et al., 2005)). The present research period went from 2006 to 2016, which cover a period prior to a period during and a period after the global credit crisis. The results from L1 to L4 confirm that GDP growth had a positive and statistically significant effect on liquidity for South African banks.

5.6.6 Inflation and liquidity

A general upward increase in the prices of goods and services, over a certain period describes inflation (Bernanke & Mishkin, 1997). According to Revell (1979), the effect of inflation depends on wages and other operating costs of banks, which are increasing at a more rapid pace than inflation. The GMM coefficient for inflation for L1, L2 and L4 was positive and statistically insignificant, and for L3, it was negative and statistically insignificant. These results were not in line with the hypothesis created for this present study that inflation had a positive and statistically significant effect on liquidty and the results for L1, L2 and L4 were in line with the theory by Bonner et al. (2013), which confirms that a change in inflation is positively related to the liquidity buffers of the bank. Results from a study by Audo (2014) on Kenyan commercial banks confirms that inflation causes a lot of discomfort within the economy, especially to retirees who are living off their pension. The constant rise in prices of goods and services reduces the consumer's ability to purchase and affects some highly indebted consumers, resulting in loan repayment inability. It also has negative effects on savings, given the time value of money. This, therefore, results in the liquidity of banks being affected by inflation. The increase in the inflation rate, increase in interest rates, and changes in the real domestic product growth, all have a negative effect on the bank's capital and thus it can be confirmed that inflation is one of the determinants of bank liquidity. This study however did not indicate whether the effect of inflation is significant or not. The results for L3 are substantiated by results from a study by Hackethal et al. 2010 that there is a negative relationship between inflation and bank liquidity in that an increase in inflation tends to reduce the bank's liquidity buffers.

Table 5.12: Summary of actual and expected signs of explanatory variables on the dependent variables

Independent Variables	Expected effect	Actual effect L1	Actual effect L2	Actual effect L3	Actual effect L4
CAP	Positive & Sig	Negative & Sig	Positive & Ins	Positive & Ins	Positive & Sig
SIZE	Positive & Sig	Negative & Sig	Positive & Ins	Positive & Sig	Positive & Sig
LG	Negative & Sig	Negative & Sig	Negative & Sig	Negative & Ins	Negative & Ins
NPL	Negative & Sig	Negative & Sig	Negative & Ins	Negative & Sig	Negative & Sig
GDP	Negative & Sig	Positive & Ins	Positive & Ins	Positive & Sig	Positive & Sig
CPI	Positive & Sig	Positive & Ins	Positive & Ins	Negative & Ins	Positive & Ins

Note: sig – statistically significant; ins- statistically insignificant

5.7 CHAPTER CONCLUSION

In this chapter, the descriptive statistics of the dependent and independent variables were discussed. The absence of series multicollinearity assumption was also tested and was reported in this chapter (see section 5.2). The Hausman test was also conducted to determine which model was preferred between FE and RE and the results confirmed that the RE model was preferred. The system GMM regression was conducted on the panel data and some of the major results were that capital adequacy had a positive and statistically positive effect on liquidity while NPL had a negative and statistically significant effect on liquidity. The next chapter will focus on the theoricatical framework for the present study, the conclusion and recommendations.

CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATION

6.1 INTRODUCTION

This chapter presents the summary, conclusion and remarks on the theories, empirical studies and findings relating to factors that determine the liquidity in the commercial banks of South Africa. The findings are based on the tests conducted and reported in Chapter 5. The research findings incorporate results from empirical studies and provide some insight on some policy implications, the conclusion as well as recommendations to key stakeholders in the banking sector and the regulator on how to enhance liquidity.

This chapter is organised as follows: section 6.1 presenting the introduction, 6.2 presents summary of the findings summary of the findings of the study and policy implications, whilst section 6.3 presents the shortcomings of the study and finally section 6.4 present the conclusion and recommendations for future research on the determinants of commercial banks liquidity.

6.2 SUMMARY OF FINDINGS AND POLICY IMPLICATIONS

The aim of this study was to investigate the determinants of liquidity in South African commercial banks and the relationship between these determinants and liquidity (see chapter 1). The study was motivated by various studies conducted by several authors on the determinants of bank liquidity and the regulatory framework reforms by the BCBS. The primary function of banks is to create liquidity by funding illiquid loans with liquid demand deposits. In essence, banks convert illiquid assets (loans) into liquid liabilities (deposits). This process is referred to as 'liquidity creation' (see Diamond & Rajan, 1999) and it is important, as it allows for the flow of credit within the economy (Diamond & Rajan, 1999). After the global credit crisis, liquidity became the focal point, as Berger and Bouwman (2009) argue, as it is liquidity that triggered the events that were witnessed during the global credit crisis. Before the global credit crisis, BCBS had focused on providing guidance to banks on capital management (Berger & Bouwman, 2009).

Studies on the determinants of liquidity for the South African commercial banking sector are limited, reference was therefore made to empirical studies on liquidity that

were conducted on banking sectors in America, Europe, Asia and Africa. Most of these studies identified the following bank-specific determinants: capital adequacy, SIZE, NPLs and loan growth as well as the following macroeconomic determinants: GDP growth and inflation (CPI). As part of the research, theories that were for and against some of the determinants were reviewed and included as part of the theory.

A quantitative research methodology comprising statistical types of data analysis was used to come to a conclusion in terms of the relationship between these determinants and liquidity and by replicating previous empirical studies conducted by other authors in other countries. Secondary panel data from a sample of 12 South African banks for the period 2006 to 2016 was used for the research. A GMM panel regression model was used to test for the significant change and relationship between liquidity measures as L1, L2, L3 and L4 and the bank-specific and macroeconomic variables. The results from the regression confirmed that capital adequacy, loan growth, NPLs, SIZE and GDP growth were the significant determinants of liquidity for South African commercial banks, while inflation was insignificant.

6.2.1 Findings on capital adequacy and policy implications

The researcher conducted regression analysis to test the relationship between capital adequacy and liquidity (L1, L2, L3 and L4). The results from the regression analysis were inconsistent as the GMM coefficient for capital adequacy under L1 was negative and statistically insignificant. Under L3 the GMM coefficient for capital adequacy was positive and statistically significant and the coefficients for capital adequacy in terms of L2 and L4 regressions were positive and statistically insignificant as indicated in Appendix A. The results from the L1 and L4 regression were in line with the hypothesis created for this study and the findings by Vodova (2011), which had the basis of the risk absorption argument, which states that the higher the capital adequacy ratio of a bank, the higher the bank's capacity to absorb risks and create a higher level of liquidity through its function of accepting deposits and issuing loans (see Vodova, 2011). This finding was in line with the theory by Berger and Bouwman (2009), which argues that when a bank that funds itself using a model that excludes capital, makes a loss, it would not be in a position to repay its obligations, thus making it insolvent. However, when a bank that uses the capital mechanism makes a loss, the loss is offset against the capital, while the balance sheet remains solvent. This confirms that

capital has a positive relationship with liquidity. From this, it can be concluded that capital adequacy has a positive and significant effect on liquidity. According to Berger and Bouwman (2009), if a bank that has capital makes a loss, this loss will result in a reduction in the capital base and the balance sheet will remain solvent. In essence, if a bank has a high capital ratio, this allows the bank to create liquidity. Based on the results, as a policy implication, the SARB can consider increasing the level of capital held by South African banks by introducing the transfer of an increased percentage of profits to the capital to strengthen the banks' credit loss absorption capacity further.

6.2.2 Findings on size and policy implications

The study also tested the relationship between SIZE of the bank and liquidity (L1, L2, L3 and L4). The coefficients for SIZE in terms of L2 and L4, SIZE were positive and statistically significant, the coefficient in terms of L2 was positive and statistically insignificant and the coefficient in terms of L1 was negative and statistically significant. The results for L1, L2 and L4 were in line with the hypothesis and support the 'too big to fail' argument, which states that large banks benefit from an implicit guarantee, which reduces their cost of funding and increases their risk taking ability (Dietrich et al., 2014). This study concluded that size of the bank has a positive and significant effect on liquidity. The policy implication that can be taken from this result is that banks in South Africa should continue to increase their liquidity creation function by increasing their deposit-taking ability as they grow bigger in order to expand their lending activities optimally.

6.2.3 Findings on loan growth and policy implications

The researcher analysed the relationship between loan growth and liquidity (L1, L2, L3 and L4). The coefficients for loan growth were negative and statistically insignificant for L1, L2, L3 and L4. This result supports the argument of an increase in illiquid assets. Loans are considered illiquid assets and generate high returns for the bank. This implies that an increase in illiquid assets results in a decrease in short-term liquid assets (Tesfaye, 2012). This is also in line with the Pilbeam's theory (2005), which notes that loan growth is dependent on the amount of liquidity a bank holds. Therefore, this study confirms that loan growth has a negative and significant effect on liquidity. This finding reveals that a large amounts of loans was issued against deposits without

affecting the amount of liquidity held by South African commercial banks. The policy implication of this result is that banks should continue to tighten their loan-underwriting criteria and enhance credit policies in order to improve asset quality.

6.2.4 Findings on non-performing loans and policy implications

An examination on the relationship between NPLs and liquidity (L1, L2, L3 and L4) was done. The coefficients for NPLs were negative and statistically significant for L3 and L4 and negative and statistically insignificant for L1 and L2. The results for L3 and L4 were in line with the finding from a study conducted by Vodova (2013) on determinants of bank liquidity in Hungary, which confirmed that NPLs had a negative effect on liquidity. This is supported by the theory by Bloem and Gorter (2001) that if a bank has a high number of NPLs, it leads to a reduction in the bank's ability to extend credit further, resulting in a liquidity crunch and prejudicing other creditors that are in good standing. This eventually leads to investors and depositors withdrawing their funds, thus pushing the bank into a liquidity crisis. Based on the results, this study fails to reject the hypothesis that NPLs has a negative and significant effect on liquidity. The policy implication from this result is that South African commercial banks should bolster their credit underwriting policies to ensure that good quality loans are brought unto their books, to reduce the number of NPLs and improve liquidity. The banks should also implement rigorous and proactive collection strategies to ensure that collection of NPLs is efficient and increases post write-off increases recoveries.

6.2.5 Findings on GDP growth and policy implications

A regression analysis to test the relationship between GDP growth and liquidity (L1, L2, L3 and L4) was carried out. The coefficients for GDP growth were inconsistent and not in line with the hypothesis as they were positive and statistically insignificant for L1, L2 and L4 and negative and statistically insignificant for L3. The results for L3 and L4, were in contrast with the findings from a study conducted by Aspachs et al. (2005), which found that there was a negative relationship between liquidity and GDP growth, supported by the theory that during an economic downturn, banks tend to place emphasis on liquidity, by restricted lending, and they neglect liquidity during an economic boom, when the climate is conducive to lending. This is also confirmed by findings from a study by Audo (2014), which confirmed that bank liquidity has a

negative relationship with GDP. This study is aligned with the results from L3 and L4, namely that GDP growth has a positive and significant effect on liquidity, implying that banks increased their liquidity buffers in line with economic growth. It can be confirmed that GDP has a positive and significant effect on liquidity; this study thus reject the hypothesis that GDP has a negative and significant effect on liquidity. From the South African policy implication perspective, the consideration is for the SARB to increase the regulatory liquidity ratio requirements during times of economic boom to ensure that banks have adequate liquidity during times of economic recession.

6.2.6 Findings on inflation and policy implications

Lastly, this study conducted a regression analysis to test the relationship between inflation and liquidity (L1, L2, L3 and L4). The results for inflation were inconsistent as the coefficient for inflation for L1, L2 and L4 was positive and statistically insignificant and for L3 it was negative and statistically insignificant. These results were not in line with the hypothesis created for this study and the results for L1, L2 and L4 were in line with the theory by Bonner et al. (2013), which confirms that a change in inflation is positively related to the bank liquidity buffers. This study thus can confirms that inflation has both a positive and a negative but an insignificant effect on liquidity and this study thus rejects the hypothesis that inflation has a positive and significant effect on bank liquidity. Although the results were inconsistent and not in line with the hypothesis, possible policy implication from these results is for the banks to factor the movement in inflation in their liquidity requirements to ensure that any change in inflation driven by the macroeconomic performance of the South African economy is reflected in a corresponding change in liquidity buffers.

6.3 SHORTCOMINGS OF THE STUDY

The following can be seen as shortcomings of this study:

1. There are limited studies that focused on the determinants of commercial banks liquidity in South Africa, which resulted in the researcher using theoretical and empirical studies from other countries as a point of reference.
2. The study focused on 12 registered banks in South Africa and it excluded a number of small banks in terms of assets, due to the unavailability of their financial statements. Had they been included, the analysis would also have provided

another paradigm on liquidity and bank size. It would be of a great value to have knowledge on how small banks responded to the global credit crisis.

3. The study focused only on South African registered banks. It would be insightful for the study to have included both South African and non-South African registered banks, given that the international banks can tap into the liquidity provided by their parent companies. During times of liquidity crisis, international banks receive liquidity assistance from their parents, and a study including this would have provided insight.
4. The study focused on the period 2006 to 2016, which covered the period of the global credit crisis. In order to understand the liquidity dynamics and liquidity management techniques during different periods, future study could be split to cover a period before, during and after the global credit crisis.

6.4 CONCLUSION AND RECOMMENDATION

This section will provide a conclusion and make recommendations for future research.

6.4.1 Conclusion

The broader aim of this study was twofold.

1. to investigate whether micro-economic factors that are internal to the bank (i.e. capital adequacy, size of the bank, loan growth and the level of NPLs) have an effect on South African commercial bank liquidity; and
2. to investigate whether macroeconomic factors, which are external to the bank, GDP growth and inflation rate have an effect on South African commercial bank liquidity.

The panel data was used for the sample of twelve commercial banks in South Africa from 2006 to 2016. Data was presented using descriptive statistics. Multicollinearity, heteroscedacity and autocorrelation were conducted on the data as part of the diagnostics. Correlation and regression analysis for four liquidity ratios were conducted. The following models – pooled OLS regression, FE, RE and GMM – were used. The Hausman test was also conducted to determine which model was preferred between FE and RE. However, the system GMM was preferred over the other methods due to the endogeneity problem that existed among the banks at the time of

this research. Six factors, both bank-specific (i.e. capital adequacy, SIZE loan growth, NPLs) and macroeconomic (i.e. GDP growth and inflation), were chosen and analysed. The following results can be confirmed. Capital adequacy, size and GDP have a positive and significant effect on liquidity. Loan growth and NPLs have a negative and significant effect on liquidity. Inflation has both a positive and a negative but an insignificant effect on liquidity.

The study assisted in identifying the following implications:

1. South African banks need to enhance their deposit-taking ability, to tighten their loan-underwriting criteria and credit policies, implement rigorous and proactive collection strategies;
2. the SARB should consider increasing regulatory liquidity ratio requirements during economic booms as well as exploring ways to factor in the inflation-driven performance of the South African economy to reflect a change in the liquidity buffers.

6.4.2 Recommendations

The recommendations emanating from this study were for banks to:

1. improve their credit risk management frameworks to be more prudent in their lending practices, to improve the quality of the loan book and to enhance liquidity;
2. grow their capital levels by embarking on efficient revenue enhancements activities, such as increasing retained earnings;
3. look at the clients on an overall basis and not transaction bases and improve non-interest revenue by introducing innovated products;
4. to grow their capital levels by embarking on efficient revenue enhancement activities such as increasing retained earnings. Banks look at the clients on an overall basis and not transaction bases and improve non-interest revenue by introducing innovated products; and
5. lower their liquidity risk exposure by collectively managing the capital adequacy, SIZE and loan growth and NPLs.

The recommendations emanating from this study were for the SARB to:

6. enhance capitalisation by ensuring that the sector is consolidated and thus merging smaller banks to create banks with stronger balance sheets;
7. improve its on- and off-site supervision and oversight functions by enforcing prudential relations, adherence to corporate governance practices and fostering a healthy and adequately capitalised banking sector; and
8. align its macroeconomic forecasts for inflation and GDP growth with regulatory requirements to ensure that economic performance is a catalyst for liquidity creation.

6.4.3 Suggestions for future research

The study had a limited focus on South African registered banks, whose data for the period 2006 to 2016 was available and accessible. A number of smaller banks, whose financial information was not available were not included in this study. The consequences of excluding them were that crucial information regarding banks size and liquidity was not assessed. Additionally, some of the large banks by total assets had foreign parents, who provided them with liquidity in a time of need. It would be worthwhile for a comparative study to be conducted, which would distinguish between the liquidity position of banks with and without parental support. Furthermore, the study only focused on banks that were registered in terms of the South African Bank's Act No. 94 of 1990 which excluded mutual banks. A study, which incorporates both registered and non-registered banks, should also be pursued in order to understand the determinants of registered and non-registered commercial banks in South Africa.

The period covered in this study included the global credit crisis in the period 2007 to 2009. The recommendation is for a study to be conducted to distinguish further between determinants of liquidity before, during and after the global credit crisis in order to understand whether there are differences.

The present study discovered that factors that determined bank liquidity were internal (bank's own) and external (outside of the bank). A recommendation is for a study to be conducted in the future to ascertain whether liquidity is affected by the determinants or whether the determinants are affected by liquidity.

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APPENDICES

Appendix A: L1 L1(-1) cpi cap gdp lg npl size

Pooled results

Dependent Variable: L1
Method: Panel Least Squares
Date: 02/13/18 Time: 16:42
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. error (SE)	t-statistic	Prob.
L1(-1)	1.007496	0.037494	26.87050	0.0000
CPI	0.247616	0.218858	1.131398	0.2603
CAP	-0.018162	0.048945	-0.371072	0.7113
GDP	0.342243	0.233994	1.462610	0.1463
LG	-0.042855	0.021731	-1.972038	0.0510
NPL	-0.422645	0.142139	-2.973462	0.0036
SIZE	0.000754	0.001561	0.483193	0.6299

R-squared	0.859599	Mean dependent var	0.909015
Adjusted R-squared	0.852144	SD dependent var	0.124636
SE of regression	0.047925	Akaike info criterion	-3.181792
Sum squared resid	0.259540	Schwarz criterion	-3.019188
Log likelihood	197.9075	Hannan–Quinn criter.	-3.115758
Durbin–Watson stat	1.541391		

Fixed effects

Dependent variable: L1
Method: Panel Least Squares
Date: 11/02/17 Time: 09:29
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.798588	0.243594	3.278359	0.0014
L1(-1)	0.757372	0.055305	13.69438	0.0000
CPI	-0.107216	0.219641	-0.488144	0.6265
CAP	0.099552	0.136594	0.728814	0.4678
GDP	0.012013	0.226662	0.052998	0.9578
LG	-0.102533	0.023673	-4.331167	0.0000
NPL	-0.578661	0.621677	-0.930806	0.3542
SIZE	-0.027519	0.011452	-2.402923	0.0181

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.901911	Mean dependent var	0.909015
Adjusted R-squared	0.884430	S.D. dependent var	0.124636
S.E. of regression	0.042371	Akaike info criterion	-3.340424
Sum squared resid	0.181323	Schwarz criterion	-2.899071
Log likelihood	219.4254	Hannan-Quinn criter.	-3.161189
F-statistic	51.59333	Durbin-Watson stat	1.372847
Prob(F-statistic)	0.000000		

Random effects

Dependent Variable: L1
Method: Panel EGLS (Cross-section random effects)
Date: 11/02/17 Time: 09:30
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
Swamy and Arora estimator of component variances

Variable	Coefficient	SE	t-Statistic	Prob.
C	0.226317	0.071875	3.148767	0.0021
L1(-1)	0.899992	0.047587	18.91265	0.0000
CPI	0.111869	0.198238	0.564317	0.5737
CAP	-0.143645	0.058827	-2.441816	0.0162
GDP	0.381168	0.207244	1.839225	0.0685
LG	-0.066369	0.020613	-3.219780	0.0017
NPL	-0.533121	0.130471	-4.086114	0.0001
SIZE	-0.003636	0.001962	-1.853059	0.0665

Effects specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.042371	1.0000

Weighted Statistics

R-squared	0.869228	Mean dependent var	0.909015
Adjusted R-squared	0.861054	S.D. dependent var	0.124636
S.E. of regression	0.046459	Sum squared resid	0.241741
F-statistic	106.3500	Durbin-Watson stat	1.430043
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.869228	Mean dependent var	0.909015
Sum squared resid	0.241741	Durbin-Watson stat	1.430043

Correlated Random Effects – Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000000	7	0.7000

* Cross-section test variance is invalid. Hausman statistic set to zero.
** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
L1(-1)	0.757372	0.899992	0.000794	0.0000
CPI	-0.107216	0.111869	0.008944	0.0205
CAP	0.099552	-0.143645	0.015197	0.0485
GDP	0.012013	0.381168	0.008425	0.0001
LG	-0.102533	-0.066369	0.000136	0.0019
NPL	-0.578661	-0.533121	0.369460	0.9403
SIZE	-0.027519	-0.003636	0.000127	0.0343

Cross-section random effects test equation:
Dependent Variable: L1
Method: Panel Least Squares
Date: 11/02/17 Time: 09:31
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.798588	0.243594	3.278359	0.0014
L1(-1)	0.757372	0.055305	13.69438	0.0000
CPI	-0.107216	0.219641	-0.488144	0.6265
CAP	0.099552	0.136594	0.728814	0.4678
GDP	0.012013	0.226662	0.052998	0.9578
LG	-0.102533	0.023673	-4.331167	0.0000
NPL	-0.578661	0.621677	-0.930806	0.3542
SIZE	-0.027519	0.011452	-2.402923	0.0181

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.901911	Mean dependent var	0.909015
Adjusted R-squared	0.884430	S.D. dependent var	0.124636
S.E. of regression	0.042371	Akaike info criterion	-3.340424
Sum squared resid	0.181323	Schwarz criterion	-2.899071
Log likelihood	219.4254	Hannan-Quinn criter.	-3.161189
F-statistic	51.59333	Durbin-Watson stat	1.372847
Prob(F-statistic)	0.000000		

GMM

Dependent Variable: L1
Method: Panel GMM EGLS (Cross-section random effects)
Date: 11/02/17 Time: 09:33
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
2SLS instrument weighting matrix
Swamy and Arora estimator of component variances
Instrument specification: C L1(-1) CPI CR GDP LG NPL SIZE
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.226317	0.071875	3.148767	0.0021
L1(-1)	0.899992	0.047587	18.91265	0.0000
CPI	0.111869	0.198238	0.564317	0.5737
CAP	-0.143645	0.058827	-2.441816	0.0162
GDP	0.381168	0.207244	1.839225	0.0685
LG	-0.066369	0.020613	-3.219780	0.0017
NPL	-0.533121	0.130471	-4.086114	0.0001
SIZE	-0.003636	0.001962	-1.853059	0.0665

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.042371	1.0000

Weighted Statistics

R-squared	0.869228	Mean dependent var	0.909015
Adjusted R-squared	0.861054	S.D. dependent var	0.124636
S.E. of regression	0.046459	Sum squared resid	0.241741
Durbin-Watson stat	1.430043	J-statistic	3.53E-21
Instrument rank	8		

Unweighted Statistics

R-squared	0.869228	Mean dependent var	0.909015
Sum squared resid	0.241741	Durbin-Watson stat	1.430043

Appendix B: L2 L2(-1) cpi cap gdp lg npl size

Panel Least Squares

Dependent Variable: L2
Method: Panel Least Squares
Date: 11/04/17 Time: 08:48
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L2(-1)	0.735706	0.065231	11.27841	0.0000
CPI	0.636159	0.630040	1.009713	0.3148
GDP	0.633392	0.718333	0.881752	0.3798
CAP	0.270392	0.156767	1.724795	0.0873
NPL	-1.432674	0.550416	-2.602893	0.0105
LG	-0.014017	0.059256	-0.236551	0.8134
SIZE	0.016063	0.004688	3.426204	0.0009

R-squared	0.785782	Mean dependent var	1.430201
Adjusted R-squared	0.774408	S.D. dependent var	0.309206
S.E. of regression	0.146862	Akaike info criterion	-0.942083
Sum squared resid	2.437238	Schwarz criterion	-0.779479
Log likelihood	63.52495	Hannan-Quinn criter.	-0.876048
Durbin-Watson stat	1.687593		

Fixed Effects

Dependent Variable: L2
Method: Panel Least Squares
Date: 11/04/17 Time: 08:51
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.418337	0.712579	0.587075	0.5585
L2(-1)	0.650093	0.068634	9.471818	0.0000
CPI	0.041185	0.690166	0.059674	0.9525
GDP	-0.460816	0.716120	-0.643490	0.5214
CAP	1.769377	0.419506	4.217765	0.0001
NPL	2.297705	2.032679	1.130383	0.2610
LG	-0.161410	0.074423	-2.168824	0.0324
SIZE	0.003353	0.035100	0.095530	0.9241

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.843195	Mean dependent var	1.430201

Adjusted R-squared	0.815250	S.D. dependent var	0.309206
S.E. of regression	0.132905	Akaike info criterion	-1.054073
Sum squared resid	1.784030	Schwarz criterion	-0.612720
Log likelihood	82.24438	Hannan-Quinn criter.	-0.874838
F-statistic	30.17293	Durbin-Watson stat	1.668241
Prob(F-statistic)	0.000000		

Random Effects

Dependent Variable: L2
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/17 Time: 08:52
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.279914	0.163399	1.713070	0.0895
L2(-1)	0.706659	0.061419	11.50558	0.0000
CPI	0.222299	0.619234	0.358991	0.7203
GDP	0.606349	0.650257	0.932476	0.3531
CAP	0.209804	0.146211	1.434942	0.1541
NPL	-1.820039	0.547030	-3.327132	0.0012
LG	-0.075881	0.064651	-1.173710	0.2430
SIZE	0.008275	0.006219	1.330597	0.1860

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.132905	1.0000

Weighted Statistics

R-squared	0.790338	Mean dependent var	1.430201
Adjusted R-squared	0.777235	S.D. dependent var	0.309206
S.E. of regression	0.145939	Sum squared resid	2.385402
F-statistic	60.31345	Durbin-Watson stat	1.631299
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.790338	Mean dependent var	1.430201
Sum squared resid	2.385402	Durbin-Watson stat	1.631299

Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000000	7	0.7000

* Cross-section test variance is invalid. Hausman statistic set to zero.
** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
L2(-1)	0.650093	0.706659	0.000938	0.0648
CPI	0.041185	0.222299	0.092878	0.5523
GDP	-0.460816	0.606349	0.089995	0.0004
CAP	1.769377	0.209804	0.154608	0.0001
NPL	2.297705	-1.820039	3.832544	0.0354
LG	-0.161410	-0.075881	0.001359	0.0203
SIZE	0.003353	0.008275	0.001193	0.8867

Cross-section random effects test equation:
Dependent Variable: L2
Method: Panel Least Squares
Date: 11/04/17 Time: 08:55
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.418337	0.712579	0.587075	0.5585
L2(-1)	0.650093	0.068634	9.471818	0.0000
CPI	0.041185	0.690166	0.059674	0.9525
GDP	-0.460816	0.716120	-0.643490	0.5214
CAP	1.769377	0.419506	4.217765	0.0001
NPL	2.297705	2.032679	1.130383	0.2610
LG	-0.161410	0.074423	-2.168824	0.0324
SIZE	0.003353	0.035100	0.095530	0.9241

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.843195	Mean dependent var	1.430201
Adjusted R-squared	0.815250	S.D. dependent var	0.309206
S.E. of regression	0.132905	Akaike info criterion	-1.054073
Sum squared resid	1.784030	Schwarz criterion	-0.612720
Log likelihood	82.24438	Hannan-Quinn criter.	-0.874838
F-statistic	30.17293	Durbin-Watson stat	1.668241
Prob(F-statistic)	0.000000		

GMM

Dependent Variable: L2
Method: Panel GMM EGLS (Cross-section random effects)
Date: 11/04/17 Time: 08:57
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
2SLS instrument weighting matrix
Swamy and Arora estimator of component variances
Instrument specification: C L2 L2(-1) CPI CR GDP LG NPL SIZE
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.279914	0.163399	1.713070	0.0895
L2(-1)	0.706659	0.061419	11.50558	0.0000
CPI	0.222299	0.619234	0.358991	0.7203
GDP	0.606349	0.650257	0.932476	0.3531
CAP	0.209804	0.146211	1.434942	0.1541
NPL	-1.820039	0.547030	-3.327132	0.0012
LG	-0.075881	0.064651	-1.173710	0.2430
SIZE	0.008275	0.006219	1.330597	0.1860

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.132905	1.0000

Weighted Statistics

R-squared	0.790338	Mean dependent var	1.430201
Adjusted R-squared	0.777235	S.D. dependent var	0.309206
S.E. of regression	0.145939	Sum squared resid	2.385402
Durbin-Watson stat	1.631299	J-statistic	112.0000
Instrument rank	9	Prob(J-statistic)	0.000000

Unweighted Statistics

R-squared	0.790338	Mean dependent var	1.430201
Sum squared resid	2.385402	Durbin-Watson stat	1.631299

Appendix C: L3 L3(-1) cpi cap gdp lg npl size

Pooled

Dependent Variable: L3
Method: Panel Least Squares
Date: 01/22/18 Time: 16:20
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L3(-1)	0.956955	0.049034	19.51607	0.0000
CPI	-0.174945	0.315927	-0.553752	0.5808
CAP	0.030466	0.066131	0.460681	0.6459
GDP	0.691193	0.330088	2.093965	0.0385
LG	-0.046497	0.028901	-1.608820	0.1104
NPL	-0.446661	0.199906	-2.234351	0.0274
SIZE	0.003622	0.001854	1.953447	0.0532

R-squared	0.695099	Mean dependent var	0.747073
Adjusted R-squared	0.678910	S.D. dependent var	0.118933
S.E. of regression	0.067393	Akaike info criterion	-2.499974
Sum squared resid	0.513233	Schwarz criterion	-2.337371
Log likelihood	156.9985	Hannan-Quinn criter.	-2.433940
Durbin-Watson stat	2.049728		

Fixed Effects

Dependent Variable: L3
Method: Panel Least Squares
Date: 11/04/17 Time: 08:59
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.514130	0.302191	5.010497	0.0000
L3(-1)	0.587673	0.064901	9.054916	0.0000
CPI	-0.719465	0.285773	-2.517612	0.0134
GDP	0.336805	0.292530	1.151351	0.2523
CAP	-0.024979	0.174672	-0.143004	0.8866
NPL	-1.033085	0.796524	-1.296991	0.1976
LG	-0.177249	0.030566	-5.798819	0.0000
SIZE	-0.056469	0.014588	-3.871028	0.0002

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.821137	Mean dependent var	0.747073
Adjusted R-squared	0.789261	S.D. dependent var	0.118933
S.E. of regression	0.054598	Akaike info criterion	-2.833344

Sum squared resid	0.301075	Schwarz criterion	-2.391991
Log likelihood	189.0006	Hannan-Quinn criter.	-2.654108
F-statistic	25.75997	Durbin-Watson stat	1.595248
Prob(F-statistic)	0.000000		

Random Effects

Dependent Variable: L3
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/17 Time: 09:00
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.467617	0.090385	5.173632	0.0000
L3(-1)	0.755308	0.055652	13.57198	0.0000
CPI	-0.381112	0.259028	-1.471318	0.1440
GDP	0.824166	0.268649	3.067814	0.0027
CAP	-0.189897	0.068444	-2.774501	0.0065
NPL	-0.678194	0.168021	-4.036362	0.0001
LG	-0.110805	0.026509	-4.179935	0.0001
SIZE	-0.007992	0.002701	-2.958808	0.0038

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.054598	1.0000

Weighted Statistics

R-squared	0.742500	Mean dependent var	0.747073
Adjusted R-squared	0.726406	S.D. dependent var	0.118933
S.E. of regression	0.062210	Sum squared resid	0.433443
F-statistic	46.13596	Durbin-Watson stat	1.695064
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.742500	Mean dependent var	0.747073
Sum squared resid	0.433443	Durbin-Watson stat	1.695064

Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000000	7	0.7000

* Cross-section test variance is invalid. Hausman statistic set to zero.
** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
L3(-1)	0.587673	0.755308	0.001115	0.0000
CPI	-0.719465	-0.381112	0.014571	0.0051
GDP	0.336805	0.824166	0.013401	0.0000
CAP	-0.024979	-0.189897	0.025826	0.3048
NPL	-1.033085	-0.678194	0.606220	0.6485
LG	-0.177249	-0.110805	0.000232	0.0000
SIZE	-0.056469	-0.007992	0.000206	0.0007

Cross-section random effects test equation:
Dependent Variable: L3
Method: Panel Least Squares
Date: 11/04/17 Time: 09:01
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.514130	0.302191	5.010497	0.0000
L3(-1)	0.587673	0.064901	9.054916	0.0000
CPI	-0.719465	0.285773	-2.517612	0.0134
GDP	0.336805	0.292530	1.151351	0.2523
CAP	-0.024979	0.174672	-0.143004	0.8866
NPL	-1.033085	0.796524	-1.296991	0.1976
LG	-0.177249	0.030566	-5.798819	0.0000
SIZE	-0.056469	0.014588	-3.871028	0.0002

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.821137	Mean dependent var	0.747073
Adjusted R-squared	0.789261	S.D. dependent var	0.118933
S.E. of regression	0.054598	Akaike info criterion	-2.833344
Sum squared resid	0.301075	Schwarz criterion	-2.391991
Log likelihood	189.0006	Hannan-Quinn criter.	-2.654108
F-statistic	25.75997	Durbin-Watson stat	1.595248
Prob(F-statistic)	0.000000		

GMM

Dependent Variable: L3
Method: Panel Generalized Method of Moments
Date: 11/04/17 Time: 09:02
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
2SLS instrument weighting matrix
Instrument specification: C L3 L3(-1) CPI GDP CR NPL LG SIZE
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L3(-1)	0.956955	0.049034	19.51607	0.0000
CPI	-0.174945	0.315927	-0.553752	0.5808
GDP	0.691193	0.330088	2.093965	0.0385
CAP	0.030466	0.066131	0.460681	0.6459
NPL	-0.446661	0.199906	-2.234351	0.0274
LG	-0.046497	0.028901	-1.608820	0.1104
SIZE	0.003622	0.001854	1.953447	0.0532

R-squared	0.695099	Mean dependent var	0.747073
Adjusted R-squared	0.678910	S.D. dependent var	0.118933
S.E. of regression	0.067393	Sum squared resid	0.513233
Durbin-Watson stat	2.049728	J-statistic	113.0000
Instrument rank	9	Prob(J-statistic)	0.000000

Appendix D: L4 L4(-1) cpi cap gdp lg npl size

Pooled

Dependent Variable: L4
Method: Panel Least Squares
Date: 02/13/18 Time: 16:47
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L4(-1)	0.699768	0.069741	10.03381	0.0000
CPI	0.238317	0.644238	0.369921	0.7121
CAP	0.428074	0.155703	2.749307	0.0070
GDP	1.469592	0.710087	2.069595	0.0408
LG	-0.061627	0.057905	-1.064280	0.2895
NPL	-1.539735	0.510229	-3.017731	0.0031
SIZE	0.016279	0.004192	3.883076	0.0002

R-squared	0.714670	Mean dependent var	1.172541
Adjusted R-squared	0.699520	S.D. dependent var	0.265581
S.E. of regression	0.145581	Akaike info criterion	-0.959604
Sum squared resid	2.394907	Schwarz criterion	-0.797000
Log likelihood	64.57621	Hannan-Quinn criter.	-0.893569
Durbin-Watson stat	1.700541		

Fixed effects

Dependent Variable: L4
Method: Panel Least Squares
Date: 11/04/17 Time: 09:03
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.167566	0.675447	1.728584	0.0869
L4(-1)	0.584866	0.071735	8.153115	0.0000
CPI	-0.844281	0.656582	-1.285873	0.2014
GDP	0.307918	0.676405	0.455226	0.6499
CAP	1.660300	0.398705	4.164229	0.0001
NPL	1.519787	1.947976	0.780188	0.4371
LG	-0.301960	0.070652	-4.273877	0.0000
SIZE	-0.029095	0.033366	-0.871981	0.3853

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.807583	Mean dependent var	1.172541
Adjusted R-squared	0.773291	S.D. dependent var	0.265581

S.E. of regression	0.126454	Akaike info criterion	-1.153584
Sum squared resid	1.615047	Schwarz criterion	-0.712231
Log likelihood	88.21505	Hannan-Quinn criter.	-0.974349
F-statistic	23.55008	Durbin-Watson stat	1.435928
Prob(F-statistic)	0.000000		

Random Effects

Dependent Variable: L4
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/17 Time: 09:03
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.589161	0.163434	3.604894	0.0005
L4(-1)	0.603021	0.066257	9.101278	0.0000
CPI	-0.462914	0.592440	-0.781369	0.4362
GDP	1.431818	0.616880	2.321063	0.0221
CAP	0.332570	0.137816	2.413146	0.0174
NPL	-2.424293	0.506586	-4.785552	0.0000
LG	-0.188477	0.061384	-3.070463	0.0027
SIZE	0.000190	0.005760	0.033061	0.9737

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.126454	1.0000

Weighted Statistics

R-squared	0.739428	Mean dependent var	1.172541
Adjusted R-squared	0.723142	S.D. dependent var	0.265581
S.E. of regression	0.139742	Sum squared resid	2.187106
F-statistic	45.40330	Durbin-Watson stat	1.463656
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.739428	Mean dependent var	1.172541
Sum squared resid	2.187106	Durbin-Watson stat	1.463656

Hausman test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.000000	7	0.7000

* Cross-section test variance is invalid. Hausman statistic set to zero.
** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
L4(-1)	0.584866	0.603021	0.000756	0.5091
CPI	-0.844281	-0.462914	0.080115	0.1779
GDP	0.307918	1.431818	0.076983	0.0001
CAP	1.660300	0.332570	0.139973	0.0004
NPL	1.519787	-2.424293	3.537983	0.0360
LG	-0.301960	-0.188477	0.001224	0.0012
SIZE	-0.029095	0.000190	0.001080	0.3729

Cross-section random effects test equation:
Dependent Variable: L4
Method: Panel Least Squares
Date: 11/04/17 Time: 09:04
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.167566	0.675447	1.728584	0.0869
L4(-1)	0.584866	0.071735	8.153115	0.0000
CPI	-0.844281	0.656582	-1.285873	0.2014
GDP	0.307918	0.676405	0.455226	0.6499
CAP	1.660300	0.398705	4.164229	0.0001
NPL	1.519787	1.947976	0.780188	0.4371
LG	-0.301960	0.070652	-4.273877	0.0000
SIZE	-0.029095	0.033366	-0.871981	0.3853

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.807583	Mean dependent var	1.172541
Adjusted R-squared	0.773291	S.D. dependent var	0.265581
S.E. of regression	0.126454	Akaike info criterion	-1.153584
Sum squared resid	1.615047	Schwarz criterion	-0.712231
Log likelihood	88.21505	Hannan-Quinn criter.	-0.974349
F-statistic	23.55008	Durbin-Watson stat	1.435928
Prob(F-statistic)	0.000000		

GMM

Dependent Variable: L4
Method: Panel Generalized Method of Moments
Date: 11/04/17 Time: 09:05
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 12
Total panel (balanced) observations: 120
2SLS instrument weighting matrix
Instrument specification: C L4 L4(-1) CPI GDP CAP NPL LG SIZE
Constant added to instrument list

Variable	Coefficient	Std. Error	t-Statistic	Prob.
L4(-1)	0.699768	0.069741	10.03381	0.0000
CPI	0.238317	0.644238	0.369921	0.7121
GDP	1.469592	0.710087	2.069595	0.0408
CAP	0.428074	0.155703	2.749307	0.0070
NPL	-1.539735	0.510229	-3.017731	0.0031
LG	-0.061627	0.057905	-1.064280	0.2895
SIZE	0.016279	0.004192	3.883076	0.0002

R-squared	0.714670	Mean dependent var	1.172541
Adjusted R-squared	0.699520	S.D. dependent var	0.265581
S.E. of regression	0.145581	Sum squared resid	2.394907
Durbin-Watson stat	1.700541	J-statistic	113.0000
Instrument rank	9	Prob(J-statistic)	0.000000